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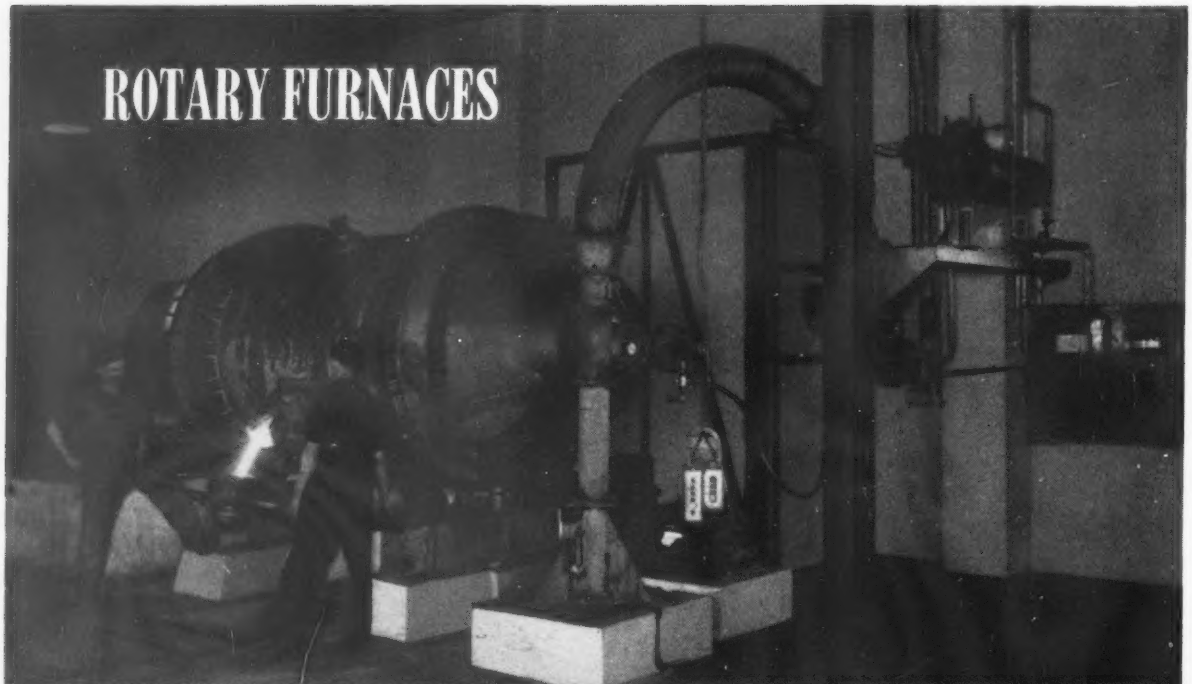
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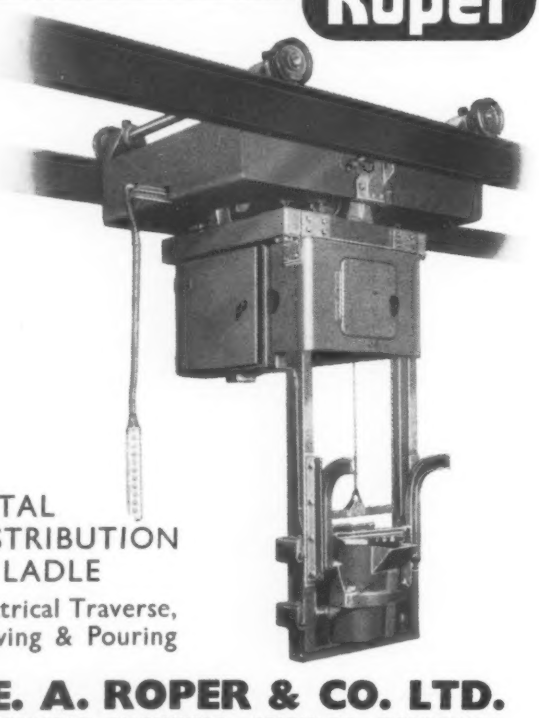

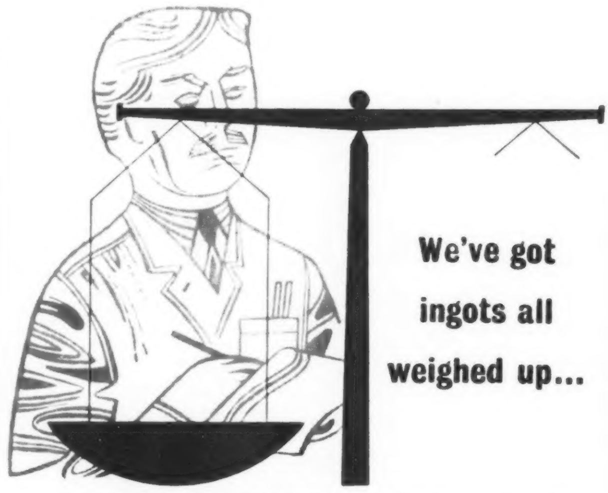


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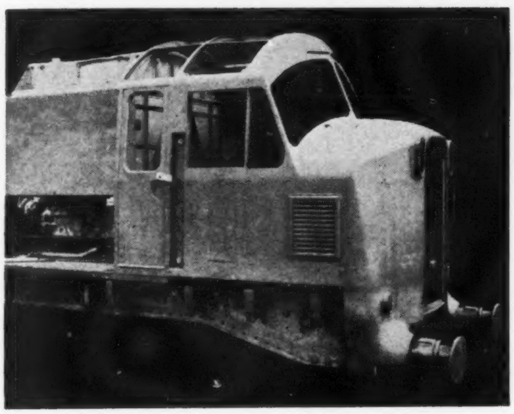

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METAL INDUSTRY

VOLUME 95 NUMBER 12 30 OCTOBER 1959

Minister for Science

ON several occasions recently personalities in the educational world have, not by any means for the first time, drawn attention to the serious lack of teachers of science in all types of educational institutions, from the Universities downwards. This shortage has reached a most serious stage, in which not only our schools and colleges must suffer but ultimately industry must be affected. It was with this in mind that we awaited the outcome of the press conference which was held last week by the Lord Privy Seal—Lord Hailsham—who is the first British Minister for Science.

In his introductory remarks, Lord Hailsham explained that he was well aware of the magnitude of the task which had been given him, and the nature and limitations of his powers and duties. After his two years as Lord President of the Council he was convinced that there was need for a policy for science, and that policy could not be the product of Government thinking alone. The indispensable partners in the field of science are industry, agriculture, medicine, teaching, the Universities and Government, and, of course, both the scientists and the non-scientists who play their part in the administration of the various branches of public and economic life. If only because of the very multiplicity of scientific disciplines, Government science, and, perhaps, all British science, is at the moment, said Lord Hailsham, too parochially minded, too departmentalized and lacking in the broader vision. The Research Councils (D.S.I.R., M.R.C., A.R.C., O.R.C. and Nature Conservancy) and the Atomic Energy Authority are, by their very terms of reference, limited in their spheres.

For the purpose of advising the Government on scientific policy, the proper channel already exists in the form of the Advisory Council on Scientific Policy. Lord Hailsham believes that this body provides one of the keys to the present situation. A greater use of this body is inevitable and his purpose was to make the voice of science coherent and articulate under Government encouragement, and in one real sense to make science self-governing under Government inspiration. He also hoped to show a personal interest in the applied research which is very widely carried out by private industry and in industrial research associations under the general authority of the D.S.I.R. But execution of all this work will continue to rest with the bodies entrusted by Parliament with those functions.

Continuing, Lord Hailsham said that in many ways the clue to the picture of science in this country lies with the Universities—especially with those which have great potentialities for growth and, indeed, an increase in numbers. The teaching of science in the schools is again not a matter for the Minister for Science but for the teaching profession, and his contact with that profession must be through the Minister of Education, and, while keeping a close liaison with that Minister in these matters, Lord Hailsham said that he would also try to seek guidance from the representatives of independent schools.

While realizing the enormity of the job which has been entrusted to the Minister for Science, if he can, as a result of his efforts, introduce more teachers for the schools, technical institutes and colleges, then one, at least, of the urgent needs of technological education in this country will have been achieved.

Out of the MELTING POT

Frictional Deformation

FRICTION and lubrication are not purely surface effects. Some of the effects produced by one metal sliding upon another, e.g. work-hardening and the associated development of internal stresses, extend to a certain depth below the sliding surfaces in contact. So far as any lubricant is concerned, it may influence some of these effects by virtue of the influence of any surface-active constituents on the surface energy of the metal and, therefore, on the mechanical behaviour of the metal in the surface layers. These effects usually pass unnoticed in the commonly used types of friction, wear and lubricant testing apparatus in which some form of slider is moved over the surface of a relatively massive specimen with or without lubrication of the surface. A chance to observe the consequences of some of these effects is provided by a friction test developed by V. D. Evdokimov and A. S. Radchik, of the Odessa Polytechnic Institute. In this test, the bearing material is used in the form of a long, thin strip. This strip is laid on a flat, horizontal, rigid supporting surface, and one end of the strip is suitably clamped to this surface. A loaded slider is then moved over the surface of the strip in the direction from its clamped end to its free end. The slider can be made to perform a number of such passes over the strip. The friction and the accompanying plastic deformation of the test strip causes a permanent upward deflection of the free end of the strip. This deflection increases with the number of passes of the slider, attaining a constant value after 4 to 7 passes. In experiments with various lubricants, it was found that the magnitude of the deflection of the free end of the strip depends, other conditions remaining equal, on the lubricating properties of the oil and the presence of surface-active substances. Measurements of the microhardness of the test surface of the strip showed that the deflection varied inversely as the microhardness.

Beyond Knowledge

IT was Newton who compared the understanding that he had gained of the natural laws to a few pebbles picked up and examined from a vast expanse of sea shore stretching out in front of him. Since Newton's time quite a few more pebbles have been picked up and examined. Indeed, the collection has become so large that, where Newton was able to derive some simple pleasure from his few pretty pebbles, it is rather difficult to handle and almost impossible to enjoy the present accumulation. Another consequence of its unwieldy size, and of the troubles to which this gives rise, is the loss of interest in the metaphorical sea shore from which the collection has been gathered. For all the interest that is taken in it, it may well be still as vast and may still appear as untouched as in Newton's time. Speculation, humble or otherwise, is, however, being rigorously shunned. For practical purposes, it seems, the facile assumption that: "there is still quite enough where the last lot came from" is regarded as sufficient. A close survey of what is left may, therefore, be a waste of time of which, as it is, there is hardly enough for dealing with the "last lot." On the other hand, such a survey might suggest that the supply is, in fact, running out and that the law of diminishing returns is already beginning to operate. This comforting or alarming (depending which way you look at it) conclusion would not, of course, mean that the supply was exhausted but that, as in the case of the thousands of tons of gold in the sea, the remainder would stay for ever inaccessible, or at least that its extraction would prove whatever the mental equivalent of uneconomic might be. And yet, would a proof of the existence of an unlimited supply—of an "endless frontier"—be any more comforting? It could be comforting only to somebody who looks upon the quest for knowledge as akin to the operation of a sausage machine of which he is quite content forever to turn the handle. It could, however, also be comforting to anybody who is content to admire the sea shore while realizing that its pebbles can never be counted, let alone identified.

Surface Effects in Depth

RECENTLY, the work of the school of research under P. A. Rebinder, in Russia, concerned with the effects of surface-active materials on the mechanical properties of solids, has been turning its attention from organic surface-active materials to metals having the same effect. Thus, studies have been made on the embrittlement and the reduction in strength caused by molten tin applied to single crystals of zinc and cadmium, of mercury on single crystals of zinc and tin, liquid gallium on lead, etc. In all cases, the effects are due to the marked lowering of the surface tension of the solid. This reduction may, in some cases, go so far that the solid begins to exhibit a tendency to undergo spontaneous dispersion into particles of colloidal dimensions. Some interesting observations were made in the course of a recent study on the effect of gallium applied to single crystals of high-purity tin at room temperature. The gallium, or the gallium-tin alloy which formed on application, was normally liquid at room temperature. Application of the gallium caused a rapid reduction in the ductility and tensile strength of the single-crystal tin specimens. This reduction continued for some time: after a few days at room temperature, the specimens could be crushed to a powder by pressing with a finger nail. X-ray examination showed that, following the application of the gallium, the single-crystal structure gradually broke up into disoriented blocks, the Laue diagram after a few days approximating to that of polycrystalline metal. Depending on the original orientation of the single-crystal specimens, application of gallium caused a decrease or increase in electrical resistance, the latter, in both cases tending towards that of the polycrystalline metal. Particular interest attaches to the results of tensile tests in liquid nitrogen on single-crystal and polycrystalline specimens of tin to some of which gallium had been applied. The strength of gallium-treated single-crystal specimens was found to be higher than that of untreated specimens, but the elongations were, of course, much lower. However, in the case of polycrystalline specimens, not only was the tensile strength almost doubled, but the gallium-treated specimens likewise exhibited a definite increase in elongation. It is suggested that this observation may well be found to point to a new approach to the production of high-strength alloys.

Skimmer

REVIEW OF BRITISH AND AMERICAN INFORMATION

Aluminium-Copper-Silicon Casting Alloys

By J. RIDLEY, B.Sc.(Eng.)Met.

(*Concluded from* METAL INDUSTRY: 23 *October,* 1959)

RESULTS quoted below for heat-treated alloys are largely for high-strength materials, the majority of which contain 2-5 per cent copper, 0-7 per cent silicon. All the alloys were artificially aged after solution treatment, with the exception of the binary aluminium-silicon alloys which were naturally aged; the latter alloys can be materially hardened by solution treatment but cannot usefully be age-hardened.[29]

The highest strengths of sand cast heat-treated alloys[2,4,5,12,17,24,25,27,29,36] were obtained from high-purity binary alloys containing 4-5 per cent copper (Fig. 5). Alloys containing greater or lesser amounts of copper have lower strength, while elongation decreases continuously with copper content.

Additions of silicon to aluminium-copper alloys generally reduce elongation. Tensile strength is not greatly affected in alloys having copper contents below 4 per cent, but the reduction is more marked[2] in the region of highest strength at 4½ per cent copper.

The presence of impurities in sand cast and heat-treated alloys[29,30,32-35,37,38] reduces tensile strength, particularly of the highest strength alloys, and the elongation is also reduced except in alloys containing 5-6 per cent or more of copper + silicon (Fig. 6).

The few results for low-purity alloys in the chill cast and heat-treated condition[29,30,32-35,38] are in Fig. 7. They require little comment.

Effect of Magnesium. Magnesium combines with silicon to form the intermetallic compound Mg_2Si, and increases age-hardening. Consequently, magnesium-bearing alloys are generally stronger but less ductile than magnesium-free material. This effect is used in high-silicon, low-copper alloys, which would otherwise have a more limited application owing to their lower range of strength, an addition of 0·2-0·8 per cent magnesium being made when required.

In other alloys, magnesium present as impurity causes elongation to be sharply reduced; it is therefore usually limited to 0·15 per cent maximum, and sometimes even lower.

The effect of 0·15 per cent magnesium in sand cast, low-purity alloys not heat-treated[4,18,22,23] is shown in Fig. 8. Tensile strength is little affected by such small additions of magnesium. Proof stress is more markedly increased, by up to 1-1½ tons/in^2 at high alloy contents, and there is an accompanying reduction in elongation of 1 per cent at low alloy contents and ½ per cent at high alloy contents. Greater additions of magnesium to low-purity sand cast alloys reduce the ductility still further[18,23,29] (Fig. 9b), while tensile strength probably remains unchanged (making some allowance for the different types of test bar used in Figs. 8 and 9b). In alloys containing 6 per cent silicon and 1 per cent or more copper, tensile strength falls when the magnesium content exceeds approximately 0·3 per cent.[23]

In sand cast alloys of high-commercial purity, the addition of 0·35 per cent magnesium (Fig. 9a) is similarly without effect on tensile strength,[29] but has a much greater influence on ductility, the elongation being reduced from about 10 per cent to less than 3 per cent in some compositions (compare Fig. 3).

Magnesium has a greater effect in chill castings than in sand castings in the as-cast condition, particularly on ductility.[23]

In chill cast aluminium-12 per cent silicon alloy, however, the first addition of magnesium causes a reduction in tensile strength, probably owing to a coarsening of the structure produced by chilling,[29,39] which is normally partly modified.

The tensile properties of alloys containing 0·35 per cent magnesium in the sand cast, solution-treated and naturally aged condition[29] are given in Fig. 10. Unfortunately, these results cannot be directly compared with those in Figs. 5 and 6 because of the difference in heat-treatment, but the effects of magnesium on tensile properties are clearly more pronounced in heat-treated alloys than in the as-cast materials. Other results[29] show that in low-purity, chill cast and fully heat-treated aluminium-silicon alloys, an addition of 0·4 per cent magnesium doubles tensile strength, more than trebles yield stress, while elongation is reduced from over 12 per cent to about 3 per cent. The addition of 1·25 per cent copper to such alloys further increases proof stress and tensile strength, and reduces elongation,[40] but the relationship between strength and ductility within the composition range investigated shows that for the same

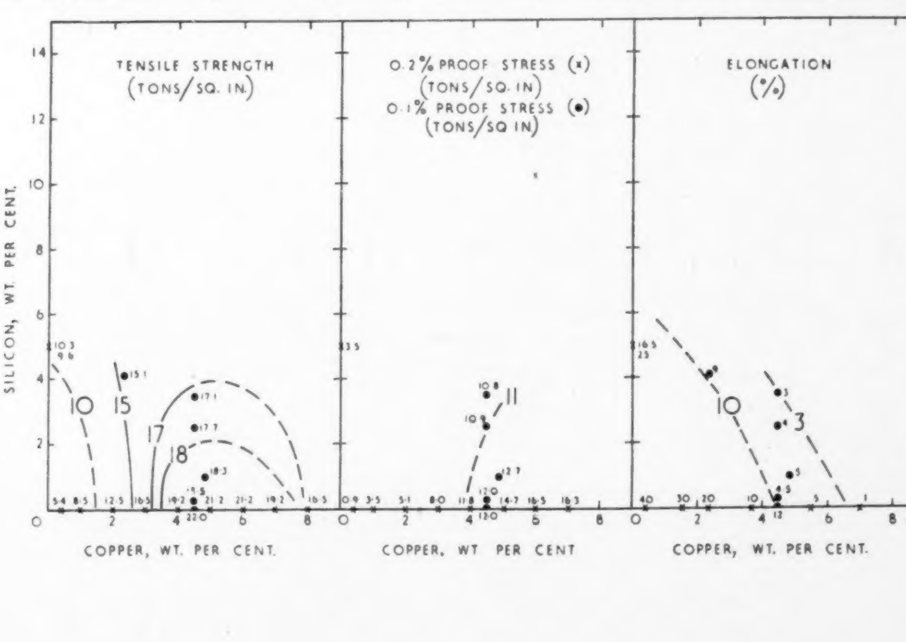

Fig. 5—Tensile properties of high commercial purity alloys, sand cast and heat-treated (British information (•) American information (x)

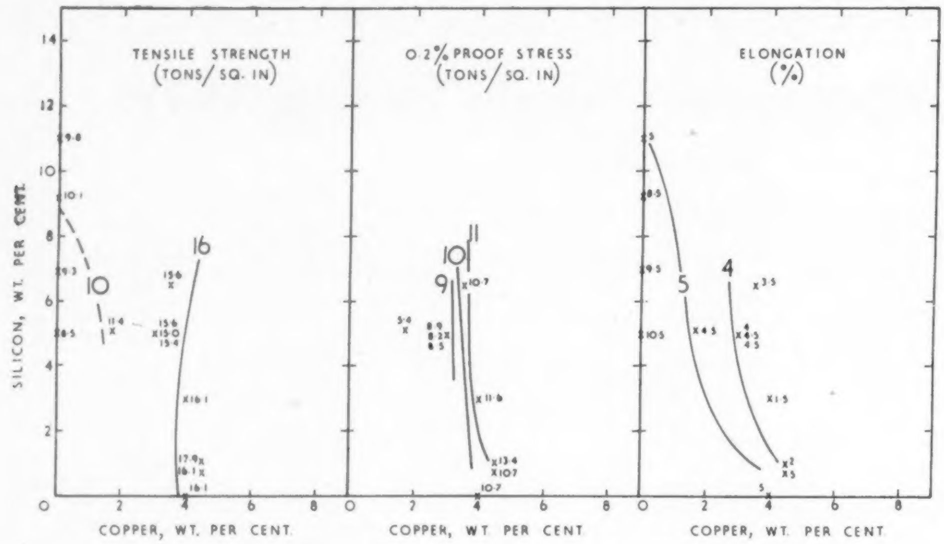

Fig. 6—Tensile properties of low purity alloys, sand cast and heat-treated (American information)

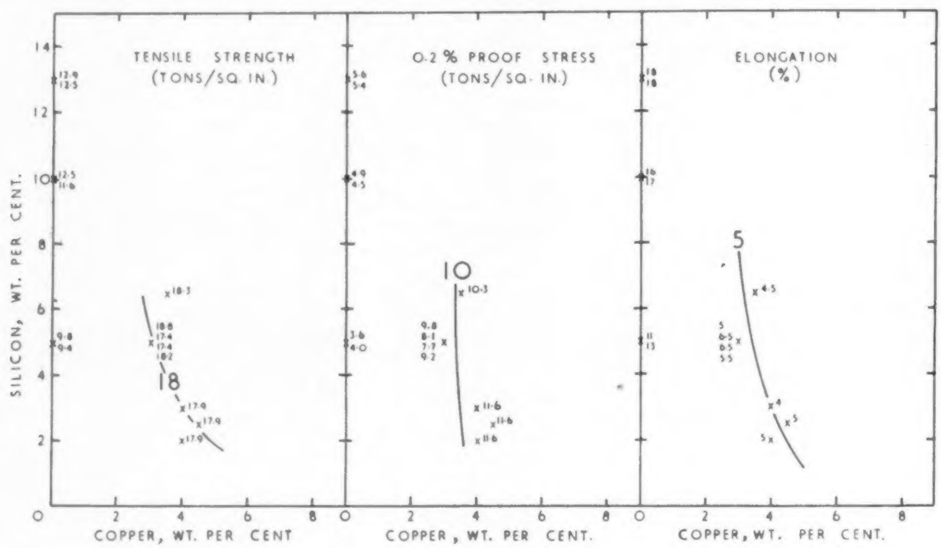

Fig. 7—Tensile properties of low purity alloys, chill cast and heat-treated (American information)

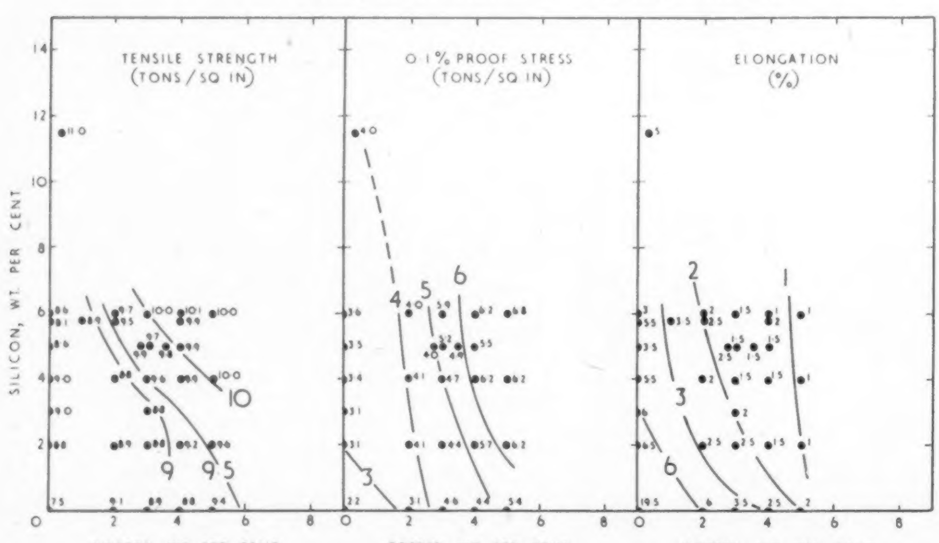

Fig. 8—Tensile properties of low purity alloys containing 0·15 per cent magnesium, sand cast (British information)

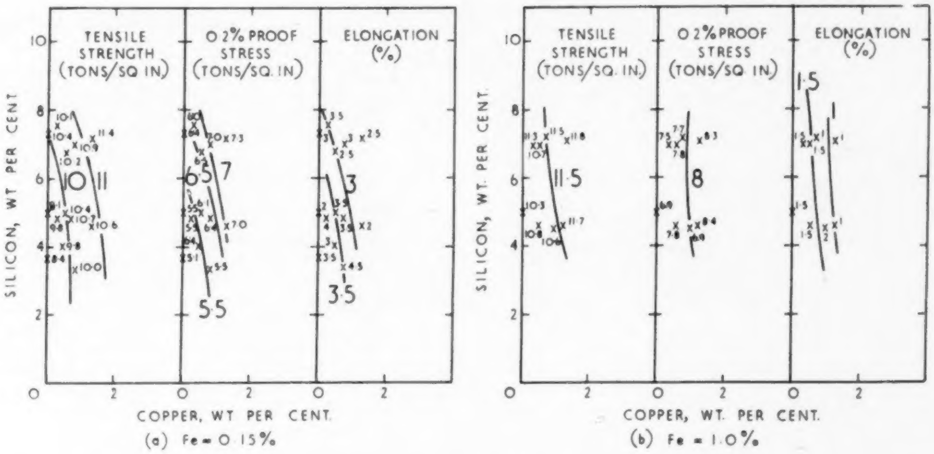

Fig. 9—Tensile properties of alloys containing 0·35 per cent magnesium, 0·15 or 1·0 per cent iron as sand cast (American information)

strength, ductility is reduced more by magnesium than by copper.

Other Impurities. It has been shown by Archer and Kempf,[29] Lemon and Hunsicker,[40] and Mascré[41] that iron has a deleterious effect on ductility in both sand and chill castings.

The effect of iron on the tensile properties of aluminium-silicon alloys varies with the method of casting. In sand cast alloys,[29,41] iron reduces tensile strength, particularly of heat-treated alloys, and increases proof stress slightly, but in chill cast alloys,[40,41] iron has much less effect.

In heat-treated aluminium-4½ per cent copper alloys the addition of 0·3 per cent iron reduces tensile strength by 3 tons/in^2, proof stress by 2 tons/in^2 and ductility from 12 to 8 per cent.[36] The lower proof stress is attributed to lack of copper in solid solution, much copper remaining undissolved as N-AlCuFe. It is, nevertheless, incorrect to assume that the ideal alloy should be one entirely free from insoluble constituents. Such small quantities of iron and silicon as are allowed in high-strength casting alloys are advantageous in that they stabilize the grain boundaries and prevent grain growth during solution-treatment.[42]

Manganese reduces the deleterious effects of iron by modifying the form of the aluminium-iron-silicon constituent.[26,37,41,43] In the absence of manganese, β-aluminium-iron-silicon forms as needles which embrittle the alloy. The presence of 0·3-0·5 per cent manganese in most commercial alloys promotes the formation of α-aluminium-iron-silicon which crystallizes in a script form and causes less embrittlement. When manganese is absent, therefore, less iron can be tolerated as an impurity.

Zinc, in amounts up to 2 per cent, and possibly higher, has little deleterious effect on tensile properties at room temperature.[19,20]

Corrosion Resistance

Summaries have been published of the influence of alloying elements and impurities on the corrosion resistance of aluminium casting alloys.[44,45] Results in Table IV indicate the relative effects of copper and silicon in sand cast and chill cast alloys.[46]

Additions of copper greater than 1 per cent significantly reduce the corrosion resistance of aluminium, the effect being pronounced at 4 per cent or more. The binary aluminium-silicon alloys, on the other hand, possess good corrosion resistance and there is some evidence that silicon additions improve the corrosion properties of alloys containing copper. Investigations of pressure die-castings[47,49] have led to similar conclusions, corrosion resistance falling with increase in copper content.

Heat-treatment substantially reduces the loss in weight due to corrosion of alloys containing copper; the percentage loss of strength does not diminish proportionally, however, and in the high-strength binary alloys the loss may be virtually unchanged. The explanation is that corrosion of as-cast alloys takes the form of pitting, whereas in heat-treated castings it becomes intergranular, particularly if the heat-treatment is incorrect.

Impurities other than copper in aluminium - silicon and aluminium - copper-silicon alloys do not have much effect on resistance to corrosion. For example, in an aluminium-10 per cent silicon alloy, the effects of total impurities between 0·7 per cent and 1·9 per cent[46] were found to be insignificant, and only at much higher levels of impurities (4·1 per cent) did an aluminium-12 per cent silicon alloy have a markedly inferior resistance to corrosion.[47]

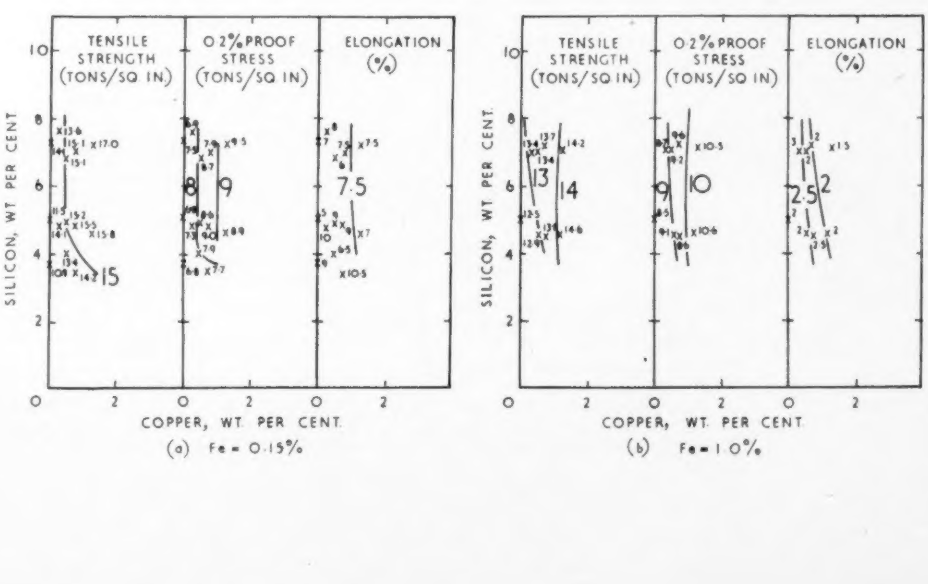

Fig. 10—Tensile properties of alloys containing 0·35 per cent magnesium, 0·15 or 1·0 per cent iron, sand cast, solution-treated and naturally aged (American information)

TABLE IV—RESISTANCE TO CORROSION*

Alloy Composition (%)	Loss of Tensile Strength % of Value Obtained After Storage in Non-Corrosive Environment		Loss of weight (gm)	
	Sand Cast	Chill Cast	Sand Cast	Chill Cast
A. As-Cast				
C.p. Al	4	2	nil	nil
Al-10 Si + impurities totalling 0·7%	10	14	0·03	0·02
Al-10 Si + impurities totalling 1·9%	10	15	0·01	0·03
Al-10 Si + 0·2 Cu + impurities totalling 0·7%	13	2†	0·03	0·03†
Al-10 Si + 0·6 Cu + impurities totalling 0·7%	6	12	0·04	0·03
Al-10 Si + 1·1 Cu + impurities totalling 0·7%	nil†	1	0·04†	0·04
Al-10 Si + 3·6 Cu + impurities totalling 0·7%	28	22	0·18	0·11
Al-10 Si + 6·4 Cu + impurities totalling 0·7%	24	nil	0·36	0·43
Al-10 Si + 0·09 Mg	nil	10†	0·02	0·03†
Al-10 Si-2·5 Cu (high purity; Fe = 0·16)	21	14†	0·13	0·10†
Al-5 Si-2·5 Cu (high purity; Fe = 0·05)	18	18	0·06	0·16
Al-5 Si-2·5 Cu (high purity; Fe = 0·20)	16	13	0·05	0·06
Al-4 Cu (total impurities <0·2%)	42	19	0·51	0·56
Al-8 Cu (total impurities <0·2%)	42	—	0·63	0·69
Al-1¼ Mn (impurities <0·6%)	nil	5	0·04	nil
B. Solution Treated and Artificially Aged				
Al-10 Si-2·5 Cu-0·16 Fe	27	16	0·04	0·01
Al-5 Si-2·5 Cu-0·05 Fe	27	26†	0·03	nil†
Al-5 Si-2·5 Cu-0·20 Fe	30	14	0·10	0·02
Al-4 Cu (impurities <0·2%)	43	24	0·18	0·14
Al-8 Cu (impurities <0·2%)	39	38	1·29	0·95

†6 months exposure only.
**Aluminium-Copper-Silicon Casting Alloys Sprayed Twice Daily with 3% Sodium Chloride Solution for 12 months. Reference 46.*

The effects of variations in iron content up to 3 per cent are not practically significant[45,47,48] though the addition of 0·01 per cent increases the rate of attack of aluminium by reagents such as caustic soda.[44] The excellent corrosion behaviour of the aluminium-1¼ per cent manganese alloy[46] suggests that manganese would not have a detrimental effect in aluminium-copper-silicon alloys, and it may even improve corrosion resistance by dissolving iron in the manganese-rich constituents.

Magnesium present in quantities up to 0·4 per cent is without significant effect on the corrosion resistance of aluminium-silicon alloys,[46,48] while zinc in quantities up to 1½ per cent[19,46-48] can usually be tolerated without any marked deterioration in resistance to corrosion.

Stress Corrosion

Failures of aluminium-base casting alloys due to stress corrosion in service are rare, and even alloys which are susceptible to stress corrosion in laboratory tests at high stresses have been used satisfactorily for periods of several years. Stress-corrosion life increases rapidly with decrease in stress, and castings are normally stressed continuously at only a small fraction of their tensile strength or proof stress.

In tests in a corrosive environment on a low-purity aluminium-4 per cent copper-1 per cent silicon alloy and an aluminium-7 per cent silicon-0·3 per cent magnesium alloy, both fully heat-treated, the copper alloy failed after eight days under the conditions used, though the cause of failure was not proved to be stress corrosion, while the 7 per cent silicon alloy remained under test for 10 months under the same conditions without signs of cracking.[50] These results were supported by another observer,[51] who also reported that the aluminium-4 per cent copper alloy, solution-treated only, has high resistance to stress corrosion.

Acknowledgment

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Polarographic Analysis

An oscilloscope specially adapted to polarographic analysis, the KOVO P.576 polaroscope, designed at the Heyrovsky Polarographic Research Institute, Prague, is being marketed in this country by Nash and Thompson Ltd., Chessington, Surrey.

The results can be observed immediately after adjusting a suitable intensity of the A.C. current, the D.C. component and setting the required size, brightness and sharpness of the picture. The oscillogram shown on the cathode ray tube is oval in shape for a pure basic electrolyte, the upper half representing the cathodic, and the lower half the anodic process. Following the introduction of a depolarizer into the electrolyte, the curve shows incisions in both anodic and cathodic parts.

The depth of the incision is proportional to concentration, and its position is characteristic of the depolarizer. The mutual position of the cathodic and anodic incisions is a measure of the reversibility of the electrode process. If they are situated at the same potential, the process is reversible; if displaced horizontally, or if one of them is absent, the process is irreversible.

The instrument is suitable for analysis in the range 10^{-3} to 5×10^{-5}M. Concentrations down to 10^{-9}M can be reached by electrolytic concentration (turning the "Micro" switch on the instrument) or by a hanging drop method. Comparative titrations can be performed by using twin electrode systems and observing two oscillograms displaced horizontally. Titrant is added until the depths of incisions coincide. Isomers and compounds of similar structure can be very easily examined and identified.

Two other instruments, the LP.54 manual polarograph, a semi-automatic conventional D.C. polarograph, and the L.55A polarograph, both designed in Prague, are also available from Nash and Thompson.

Obituary

Mr. F. W. Leake

We regret to record the death of Mr. F. W. Leake, M.I.E.E., sales manager (works administration), of British Insulated Callender's Cables Ltd. Mr. Leake joined British Insulated Cables Limited in India in 1923 and held a number of positions in the company until taking up this post in 1956.

Mr. A. Whewell

It is with regret that we record the death of Mr. Alan Whewell, managing director of J. H. Smith and Co. (Metals) Ltd., of Birmingham.

EFFECT ON DUCTILITY OF COPPER AND ITS ALLOYS

Cadmium Plating on Copper

By **D. BOXALL,** A.I.M. **and A. P. C. HALLOWES,** B.Sc., A.I.M.

An investigation into the embrittlement of copper and its alloys as a result of cadmium plating has been carried out at the British Non-Ferrous Metals Research Association, and this contribution (B.N.F.M.R.A. Tech. Memo. 144P.) surveys the results of this work. The authors are associated respectively with B.N.F.M.R.A. and the Copper Development Association.

IT is well known that when copper or copper alloys are in contact with light alloys there is a danger of the light alloys suffering local corrosion through electrolytic action arising from the presence of the more noble metal. Cadmium plating the copper or copper alloy is a precaution which is widely recommended for protecting the light alloy from galvanic corrosion in such cases. As cadmium is closer to aluminium in the galvanic series, contact potential is reduced with less chance of corrosion occurring.

However, there have been suggestions that cadmium plating can cause a serious loss in ductility of copper alloys through, it is said, diffusion of the cadmium into the copper. For example, Marsh[1] refers to the rapid failure of cadmium on copper or brass that can occur not only due to the potential difference between them but also on account of the tendency for cadmium to diffuse into copper. Electrodeposition of tin or nickel before cadmium plating the copper or copper alloy part is usually recommended in order to prevent this alleged diffusion. An Inter-Service Specification[2] for telecommunication equipment states that "a tin or nickel flash 0·0001 in. thick shall be provided before cadmium plating copper and copper alloy parts to prevent absorption of the cadmium", and similar recommendations have been made by other authorities.[3,4] No reference has been found in the literature, however, to the embrittlement of copper or its alloys by cadmium diffusion. Hydrogen embrittlement of steel during cadmium plating is, of course, a well-known but quite different phenomenon.

Practical Investigation

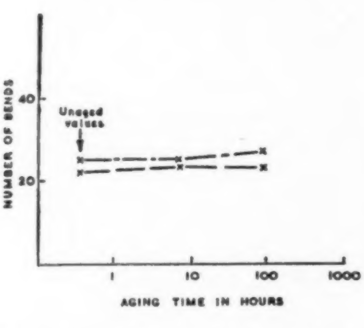
Some experiments were made at the B.N.F.M.R.A. laboratories to see whether electrodeposited cadmium was harmful to copper and its alloys in any way. Bend tests were made on unplated metal strips and the results compared with tests made on strips after plating with cadmium. To encourage diffusion some plated strips were aged at 125°C. for up to 14 days before bending and the same treatment given to unplated strips for comparison.

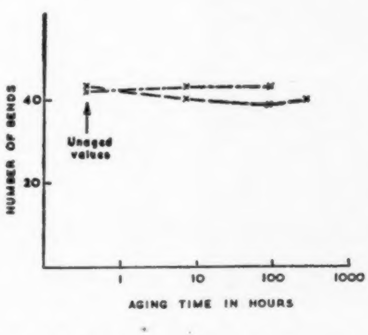
TABLE I—TEST MATERIALS

Material	British Standard Specification	Condition	Hardness (VPN)
Copper	1432	Hard Annealed	111 44
Phosphor Bronze	407/2	Extra hard Annealed	223 81
"Clock" Brass	2785-CZ119	Hard Annealed	110 73
70:30 Brass	267	Annealed	71

The test pieces were cut from 21 S.W.G. strip, details of the materials being shown in Table I.

It was thought that if embrittlement did occur it would affect the transverse properties of the strip more than the longitudinal and the test pieces were cut so that the axis of the bend was





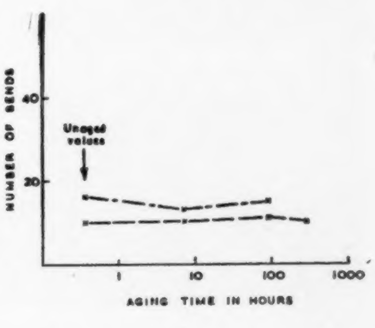


Fig. 1—Results of bend tests on tough pitch copper. Above, in the soft condition. Below, in the hard condition

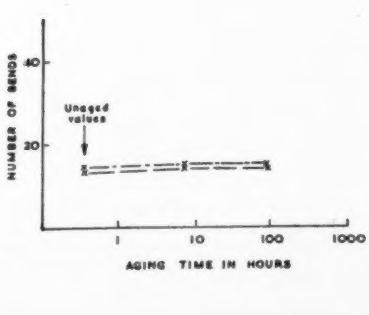
— - — - — Unplated
— — — — Plated unstressed

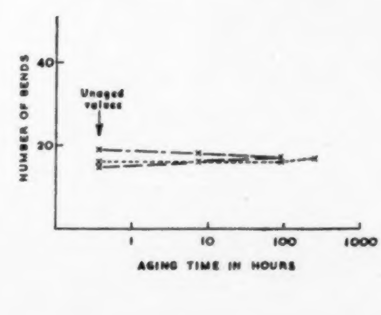
Fig. 2—Results of bend tests on phosphor bronze material. Above, in the soft condition. Below, in the hard condition

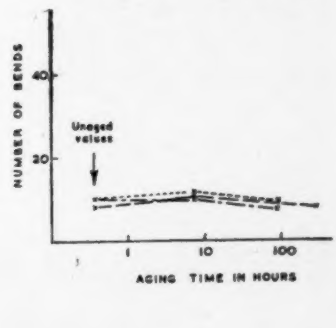
— - — - — Unplated
— — — — Plated unstressed
- - - - - - - Plated stressed

Fig. 3—Results of bend tests on clock brass material. Above, in the soft condition. Below, in the hard condition

— - — - — Unplated
— — — — Plated unstressed
- - - - - - - Plated stressed







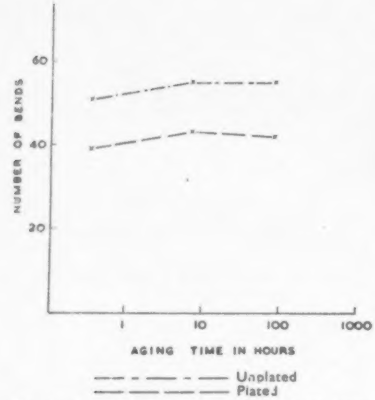


Fig. 4—Results of bend tests on 70:30 brass in the soft condition

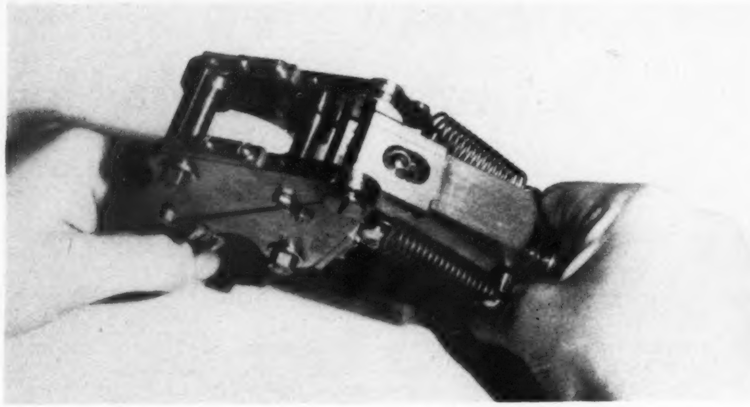


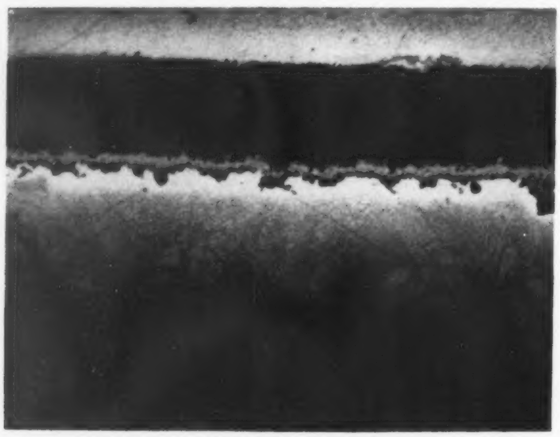
Fig. 7—B.N.F. simple reverse bend machine used for the tests

parallel to the direction of rolling. However, in some preliminary tests, the extra hard phosphor bronze fractured after very few bends, which would have made the detection of any embrittlement after plating extremely difficult. The phosphor bronze test pieces were therefore cut longitudinally, transverse tests being used for all the other materials.

Cadmium 0·0003 in. thick was deposited by the process described in specification D.T.D. 904. In case stress in the components was an important factor, some of the hard phosphor bronze and "clock" brass test pieces were stressed during plating by bending in small jigs to about 75 per cent of the 0·1 per cent proof stress.

No Embrittlement Detected

The results obtained are shown in Figs. 1 to 4. Each point on the graphs is an average of the reverse bend values for three specimens and very little scatter was observed. There is no evidence of embrittlement, if one uses the term to mean a drastic lowering of the ductility. Some tests show a reduced number of bends for the plated compared with the unplated material, particularly the annealed 70:30 brass. The plated specimens were, however, still ductile and the lower result is undoubtedly due to the cadmium coating having less ductility than the base metal so that cracks start in the coating and propagate through the test piece. Evidence to support this was obtained by chemically stripping the cadmium from a few of the 70:30 brass specimens, after which the bend values were the same as for the unplated material.

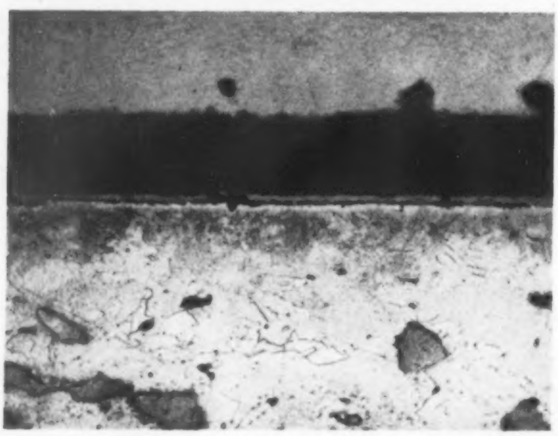


← Cadmium

← Diffusion layer

← Base

Fig. 5—Taper section through cadmium plated phosphor bronze showing the diffusion layer developed after 14 days at 125°C. × 2,700 normal to the cadmium coat (approx.)



← Cadmium

← Diffusion layer

← Base

Fig. 6—Taper section through cadmium plated clock brass showing diffusion layer developed after 14 days at 125°C. × 2,700 normal to the cadmium coat (approx.)

This effect is not confined to cadmium plating and the reverse bend value after plating the 70:30 brass with nickel was only thirty-seven bends. A recovery to fifty-four bends was obtained after stripping the nickel. A similar effect has been reported by Form and Baldwin,[5] who showed that brittle skins on ductile metals lowered their ductility in tensile tests more than would be anticipated from the percentage of bulk occupied by the skin.

Some of the specimens were examined metallographically for signs of diffusion, but no diffusion could be seen even in plated specimens which had been standing for 16 months at room temperature. Specimens which had been heated for 14 days at 125°C. did show diffusion layers as seen in Figs. 5 and 6 where the micro sections have been prepared as taper sections giving a magnification of about 2,700 in the direction normal to the coating.

The results suggest that cadmium plating on copper or copper alloys is not harmful and would cause no serious reduction in ductility of plated parts. Diffusion was not observed at room temperature, and even after 14 days at 125°C. the diffusion layers were very thin and did not reduce the bend values. The lower ductility of cadmium as compared with some fully annealed copper alloys may result in some reduction in ductility, but a similar effect is produced by nickel plating. The tin or nickel "flash" beneath the cadmium coating sometimes recommended to prevent diffusion of

cadmium into the copper or copper alloy, does not seem justified on these grounds. The protection against galvanic corrosion at joints between copper-base materials and light alloys may be superior when a tin: cadmium or nickel: cadmium coating is used rather than cadmium alone, but this does not seem to have been established.

Bend Testing Machine

The machine used for the bend tests is an improved version of one designed many years ago by C. B. Marryat of the National Physical Laboratory for studying the effect of impurities on the properties of copper in work sponsored by the B.N.F.M.R.A. The present model is shown in Fig. 7. It takes specimens about $1\frac{1}{2}$ in. long × $\frac{3}{8}$ in. wide which are bent backwards and forwards through 180° over small rollers until a fracture develops. As the diameter of the rollers is fixed at 0·3 in., comparison can only be made between test pieces having the same thickness. Bend tests in this machine have proved a sensitive method for detecting slight embrittlement of sheet material.

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2. Inter-Service Specification, RCS/1,000, Issue 2. Radio Components Standardisation Committee, Ministry of Supply, Clause 7/2/2/4, 1950, July.
3. N. R. Evans and V. E. Rance; "Corrosion and its Prevention at Bimetallic Contacts", Inter-Service Metallurgical Research Council (H.M.S.O. 1956).
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5. G. W. Form and W. M. Baldwin; *Proc. A.S.T.M.*, 1956, **56**, 645.

Barrel Finishing

IMPROVEMENTS in the finish of metal parts by processing in loose abrasives in a manner quite different from conventional barrel finishing are among the advantages claimed for a machine recently developed by the Harper Buffing Machine Company of the U.S.A. and now to be manufactured in this country by W. Canning and Co. Ltd. The machine makes possible considerable reductions in process times, and may be used to finish intricately contoured parts. Patents have been applied for, and W. Canning and Co. Ltd. have the sole rights outside the U.S.A. and Canada.

This machine (called the "Harperizer") uses fine loose abrasives. It is built to produce a high centrifugal force that holds the parts and media together in a tight mass. Abrasives and the parts being processed slowly move in relation to one another while in this tightly packed mass. As a result, certain types of intricately contoured parts can be uniformly smoothed to a finish comparable to that produced by buffing. Material removal is rapid.

The Harperizer consists of a number of containers mounted on a large turret which revolves at speeds sufficiently fast for the effective weight of the workpieces and media to be increased 40 to 50 times by the effect of centrifugal force. The containers are mounted so that they rotate on their own axes while the large turret is revolving. The containers are 37 in. long, with an inside diameter of 11 in. Removable dividers form compartments that make it possible to process products of different sizes. All containers have resilient Neoprene rubber linings.

Balancing the rotating turret and the containers is important, since the centrifugal force is substantial. Thus, machines with several containers mounted on the turret must be carefully balanced so that they are in equilibrium while the machine is operating.

Both wet and dry media can be used, and the media chosen should be fine enough to conform closely to the most intricate contours of the workpiece. Wet operations are successful in deburring and radiusing edges, and in processing parts too small or too light for normal tumbling operations.

As rotation of the turret begins, centrifugal force gradually increases until the turret reaches normal speed. The considerable force produced compacts the media and presses it against the sides of the container and against the parts. Since the container is rubber-lined, the media does not slide against the sides. Instead, the compacted abrasive materials "walk" with a caterpillar-like motion around the inner wall of the container.

The combined result of the high centrifugal force and caterpillar-like movement is that parts being finished are held tightly within the abrasive mass and the abrasives gradually slide against the surface of the parts, removing metal from the surface and refining the finish. Materials are kept compacted at all times, "waterfalling" is avoided, and there is no falling or "bombarding" of workpieces with abrasives.

Since the containers themselves are rotating, the position of greatest centrifugal force and the centre of stability constantly shifts within the container, so that all part surfaces are subjected to approximately the same action.

The sustained high pressure and slow movement of the work and abrasives cause the abrasives to abrade all surfaces to a uniform depth. Forcing the abrasives against the parts also produces rapid cutting action, and processing time is short.

The Harperizer probably is at its best in finishing parts that are difficult to process by conventional polishing methods. Thus it is suited for parts that have complicated contours which make hand polishing impracticable or those difficult to jig for automatic polishing machines. Besides producing a highly polished surface, the machine also preserves detail of design.

Examples of the products that have already been successfully finished include cams (from 80 to 18 micro in. finish without distorting contours), stainless steel flat ware with an ornamental design, steel golf club heads, die-castings, and plumbers' brassware.

Readers' Digest

FINISHING ALUMINIUM

"The Surface Treatment and Finishing of Aluminium and its Alloys." *2nd Edition. By S. Wernick and R. Pinner. Published by Robert Draper Limited, Teddington. Pp. xx + 607.* *Price* 90s.

WITH the publication of the second edition of this book on the surface treatment of aluminium and its alloys, extensive revision has been necessary. This is evidence of the rapid changes in knowledge and advances in techniques that are occurring in this field.

There is, for instance, an increase in the amount of detail on abrasive blasting for decorative purposes and to improve fatigue properties. Developments in chemical and electrolytic polishing are included, and textual revisions and additions have also been made to the data on chemical cleaning, anodic etching and chemical contouring.

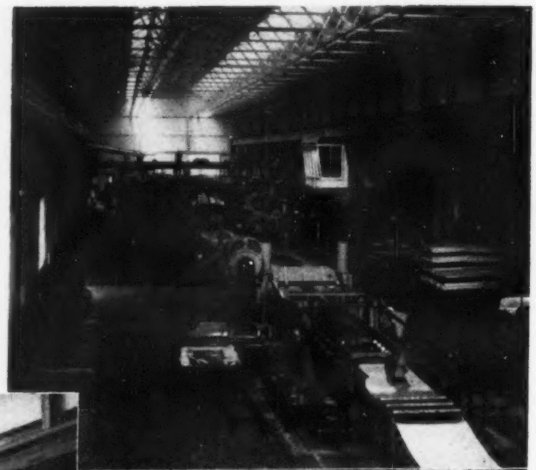
Some obsolete processes have been omitted from the current edition to make way for new material such as phosphate/chromate conversion coatings. In the range of anodizing processes, recent information on the sulphuric acid process, the constant voltage chromic acid process, automatic bright anodizing plants, hard anodizing, colouring and sealing anodic films, has been added.

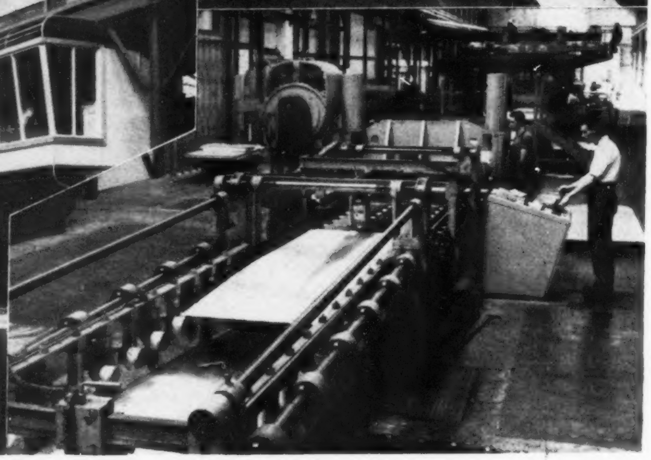
Test methods have been brought up to date, the chapters on electroplating have been enlarged and additional information has been added on vitreous enamelling.

Like the first edition, this work will equally rapidly need revising still further as "progress in the art" becomes even more advanced.

ALUMINIUM JUBILEE

CELEBRATING 50 years of aluminium production this month, Aluminium Corporation Ltd. has also recently installed at its Dolgarrog works a modern 2-high reversing hot mill for the breaking down of ingots. Equipped with up-to-date handling facilities and coiling equipment, the mill is capable of producing, at full capacity, 5 tons/hr. of hot-rolled strip for re-rolling, thus making possible a 50 per cent increase in output, with an improvement in quality. This installation, with its associated shear tables and automatic piler tables, represents a considerable step towards automation. A further development, believed to be the only one of its kind in the country, is a hot coiler, which is to be fitted to the mill later. The mill itself is of Robertson design and construction, the major part of the electrical equipment, drives, etc., being supplied by the Metal Industries Division of English Electric Co. Ltd.





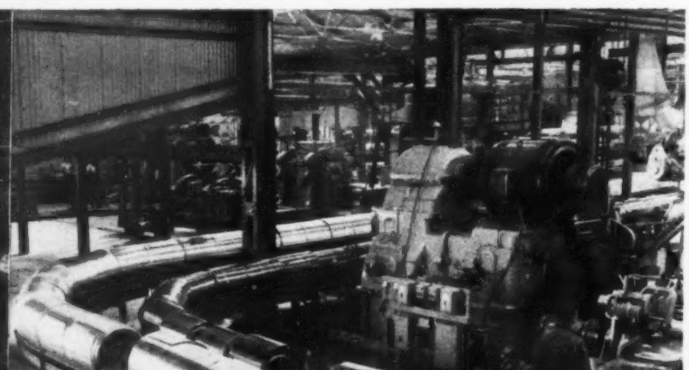
Top right: Two-high 28 in. × 60 in. hot breaking down mill showing control gallery, and, in the foreground, the hot blank shear and automatic piler

Above left: The mill stand with the control gallery alongside

Above right: The automatic piler operating on hot-rolled sheet blank

Below left: Coil conveyor transport to entry side of 2-high cold strip roughing mill

Below right: Coil ready for re-rolling on 2-high cold strip roughing mill



FURTHER PROCEEDINGS AT INSTITUTE OF METALS AUTUMN MEETING

Extrusion of Copper Rod

At the Autumn Meeting of the Institute of Metals, held in Stockholm, Session A, on Thursday, September 24, took the form of a discussion on the Paper abstracted below. On this occasion the chair was taken by the President, **Mr. G. L. Bailey,** C.B.E., M.Sc., F.I.M., and the Paper was introduced by **Mr. G. Wilson,** one of its authors. A résumé of the discussion on this Paper (*J. Inst. Met.*, 1958-59, **87**) also appears below.

Extrusion Compared with other Methods for the Manufacture of Bar, Rod and Wire Rod in Copper and Copper Base Alloys

By KUIDO GERING and GUNNAR WILSON

Available raw material is frequently the decisive factor in choosing a hot-working process, and since rod-rolling has been the predominant method of copper rod manufacture up to now copper production has been concentrated on wire bars. Thus, billets for extrusion have represented only a minor part of world consumption, and their price has been high. Further, during shortages, it has been very difficult to obtain billets. There should, however, be no reason for the manufacturing costs of billets exceeding those of wirebars by very much, and if costs were reduced, an increased demand would ensue.

Copper alloys suitable for rod rolling have high resistance to deformation at high temperatures but otherwise have good working properties, i.e., alpha brasses containing >65 per cent copper without any other alloying additions, or copper with only small additions. Rod rolling disadvantages in this case are loss of production during changeover, and risk of rolled-in fins, especially as rolling quantities per dimension become smaller. Where production of large quantities operates, rolling is to be preferred. Studies should reveal a critical quantity below which extrusion, with its greater flexibility, becomes the more economic process.

For rectangular and commutator sections universal rolling is commonly employed. Extrusion compares less favourably here by reason of sub-surface oxide stringers which may not be discovered until the commutator is built-up, and, moreover, the tool cost is lower for rolling. However, if demand does not justify continuous or otherwise highly-mechanized mills, extrusion is preferable because of higher productivity and lower finishing costs.

In the production of shafts and heavy long rod, extrusion billet size is often a limiting factor. With heavy sections, the reduction in area is small and a coarse structure is produced. Also, since most current alloys contain hard phases a fibrous texture is liable to occur in the material.

Where demand is great, rolling in grooved rolls is suitable, but cooling during rolling limits the degree of hot-working achieved. In mills with little mechanization 2 in. may be considered the lower limit. Since extrusion difficulties decrease with diminishing size, this limit may, in certain cases, constitute the boundary between extrusion and rolling.

Forging, adopted usually when other plant is not available, demands considerable craftsmanship. In continuous casting, used mainly for alloys difficult to extrude, capital investment is small and the method is suitable for small quantity production. Production per man hour may exceed that of extrusion (especially for tin bronzes) particularly when using multiple-hole moulds. Problems of cracking, inverse segregation and grain coarseness have to be solved, however.

Centrifugal casting has some advantages: a shorter path from raw material to finished product and opportunity for using scrap unsuitable for extrusion because of hot-shortness. High tool costs and low productivity prevail, but low capital investment enables centrifugal casting to compete with extrusion for large diameter rod in large quantities.

Although centrifugally cast rings enable high-quality wire to be produced, the high production cost makes this process complementary to extrusion only for a few specialized products.

Wire manufacture from circles is not very attractive and it would only compete with extrusion for producing wire of less than ¼ in. diameter from alloys that otherwise present abnormally great difficulties.

DISCUSSION

Dr. R. D. Carter (British Insulated Callender's Cables Ltd.):

Extrusion is an accepted process for the fabrication of certain high-conductivity copper manufactures, and the surface quality obtained is of the highest order. But rod rolling of copper has made at least as many strides, quality-wise, as extrusion, and the rod produced now is very different from that produced twenty years ago. In fact, present-day rod surface quality is quite good enough for at least 90 per cent of output.

Copper is not an ideal material for extrusion because of the die wear at high temperatures. Looking at the authors' comparisons between the processes in detail, it seems that they are not quite fair to extrusion in capital cost. Again, the high extrusion rates for low diameter rod must be a bugbear. The billet temperature must be high and the temperature of the rod as it emerges from the die must also be higher than in normal practice. Can the dies be maintained to give good surface quality throughout a 225 lb. coil?

At the high coiling speed (2,460 ft/min.) what cooling arrangements are there for the rod emerging from the press at high temperature? It must be necessary to cool quickly to avoid scale and, therefore, the conductivity could be affected and would be slow to recover subsequently.

The authors point out that there is no possibility of cold work in the extrusion of, for instance, cadmium-copper, but the same applies to modern rod mills.

Extruded rod could be expected to be free from ferrous inclusions, yet the difficulties experienced in drawing small wires of, say, 0.25 mm. diameter, are probably due to small inclusions of scale.

Extrusion is definitely competitive for the production of aluminium conductor rod in that it has advantages which do not apply to copper. These include the facts that billet prices are almost the same as those for wirebars, continuous extrusion can be aimed at, there is no surface oxidation and build-up of scale, and no cooling problems are involved.

The authors are right in emphasizing the importance of local conditions in choosing any process. Their Paper has raised new thoughts about the possibilities of the extrusion process; how attractive it would be, for instance, to be able to extrude copper strip of high surface quality to give a finished product with a single drawing operation.

Clement Blazey (Metal Manufacturers Ltd., Port Kembla, Australia):

If a large wire factory now buying its rod from outside sources were to decide to produce its own rod, what plant would the authors recommend?

Dr. W. O. Alexander (I.C.I. Ltd., Metals Division):

The basic price of copper is the main factor in any consideration of comparative yields. The significance of slight variations of yield is that the effect is cumulative and it is therefore important to determine the correct stage at which faulty material can be economically rejected. Any consideration of costs should include direct and indirect labour, *total* energy, fixed capital and working capital. The dominant item is that of *total* energy. The more automatic the process the less the energy costs per ton

so that the ideal to aim at is to obtain a casting nearer to finished dimensions by the use of more elaborate casting techniques.

Christopher Smith (James Booth and Co. Ltd.):

Copper is not an ideal material for the extrusion process because fine outside surfaces are accompanied by internal defects. The extrusion process is ideal for brasses but not for copper rod when compared with rolling.

H. C. Hulme (The Delta Metal Co. Ltd.):

I cannot agree that modern presses cannot compete with rod rolling. In the authors' Paper down-time has not been taken into consideration. In the case of copper tubes the container life is 50 per cent greater than in the case of rods. Yield depends on whether turned or unturned billets are used.

Dr. O. H. C. Messner (Consulting Engineer, Zurich):

In answer to Mr. Blazey, it is possible to estimate the costs of the two processes accurately but quality is the deciding factor. For the highest quality material the extrusion process is to be preferred. The rod mill is capable of high production, but the extrusion process has the advantage that it can be used for other metals than copper if required. The extrusion process has not been used to its fullest extent for the production of bright wire.

T. W. Collier (Thomas Bolton and Sons Ltd.):

Tool development is of the utmost importance. A closed die of 10 per cent tungsten steel with a Nimonic insert is being used to extrude 300 lb. of $\frac{3}{8}$ in. diameter rod with complete success.

A. B. Ashton (Frederick Smith and Co. Ltd.):

Comparing hot rolling with extrusion; in the former the faults are near the surface and, therefore, easily detected whereas in the latter process internal faults and the back end defect are more difficult to detect. These are most serious in rod that is to be used for the production of wire. Rod extruded at $\frac{3}{8}$ in. diameter is elongated 10,000 times its extruded length and any defects therefore affect enormous lengths of the final wire product. Hot rolling is to be preferred for the production of copper rod for wire manufacture but improved inspection methods could alter this verdict.

G. E. Barnard (Manganese Bronze and Brass Co. Ltd.):

Much remains to be done with materials for tools and container liners. The correct treatment of dies is most important, particularly controlled conditions of die temperature.

Dr. N. Swindells (McKechnie Bros. Ltd.):

One significant point is the speed of extrusion attained by the authors. Is this due to modern coil winding equipment?

B. Waller:

In the past three years there has been a marked decrease in the use of shaved rod for enamelled wire. Only half our production is now shaved. The tolerances on extruded rod compared with cold-drawn rod are not so good.

J. L. M. Tranier (Les Cables de Lyon de la Compagnie Générale d'Electricité):

More progress has been made with aluminium wire than with copper wire. Properzi-cast wire gives a more consistent product than that of any copper refiners.

Author's Reply

Little progress was made with the extrusion process till after the war. Due to the influence of iron and steel rolling there has been constant progress in the rod rolling process.

With regard to capital costs, buildings and space are not included in our estimates and the rolling mill was made by ourselves. The extrusion press was not designed for the high speed extrusion of copper. No surface troubles have been experienced.

With regard to scale, it was found that there was 50 per cent more on rolled rod $\frac{1}{4}$ in. in diameter than on extruded rod. Grain size is of importance for flattened wire which has to be welded.

With regard to defects, it is the frequency of their occurrence which is most important in both processes.

Danish Central Welding Institution

By HANS VINTER, M.Sc.

(Director, Central Welding Institution)

DURING the late thirties, the rapidly increasing application of the technique of welding within Danish industry, created an equally increasing demand for methods of non-destructive testing of important welds in boilers, steel structures, ships etc.

In order to meet this demand, the Danish Academy of Technical Science in co-operation with the Technical University of Copenhagen established an independent, non-profit making Institution called "Svejsecentralen" (The Danish Central Welding Institution).

The Institution was founded in 1940 with the assistance of the Federation of Danish Industries, the Danish State Factory Inspection, The Copenhagen Town Council and the Danish Welding Society. An executive Council comprising nine representatives from the organizations mentioned above, is responsible for the management.

The object of the Institution is to act as a national organization for welding inspection, testing, education and research, serving the entire Danish industry.

The Welding Institution functions as a central laboratory, carrying out inspection and non-destructive testing on building sites and in workshops all over the country, and with the exception of only a few specialized firms, nearly all Danish industries have been able to avoid the purchase of expensive testing equipment and the employment of specially qualified staff members in private testing departments.

All examinations are carried out at fixed charges calculated to cover the net costs involved in the execution of the work, and an excess of income, if any, from the activities of the Institution is, according to the statutes, to be spent on welding research work.

The principle of centralizing all testing activities within the field of welding has proved to be successful, and from a very modest start the establishment has gone through a succession of expansions following the rapid development of the welding industry.

The total number of staff members has now reached about 80, but is still increasing. The technical staff comprises 26 engineers holding degrees as Masters of Science in mechanical and structural engineering, including experienced specialists on design, welding technology, metallurgy, mechanical and non-destructive testing etc.

In 1955 the Institution moved from the Technical University into buildings of its own, and has now at its disposal a full range of laboratories and equipment, including machines for mechanical testing of materials, equipment for metallurgical examinations and chemical analyses, portable equipment for X- and Gamma-ray radiography, ultrasonic testing, magnetic particle testing etc., welding laboratories and mechanical workshops for the machining and preparation of test specimens.

In addition to the testing and inspection work, the continuous collection of practical experience during the last twenty years has led to an increasing consulting activity within the field of welding, in the later years supplemented by welding research activities sponsored partly by industrial and government research funds, and partly by individual firms.

The increasing demand for accurate, cheap and easily applied methods of non-destructive testing has gradually led to the establishment of special laboratories for development and research on the testing methods and equipment as such.

Even if the main activities in this field have been directed towards welding problems, it has only been natural, when new testing methods and equipment have been developed, to apply these within other industrial fields, and consequently, the Welding Institution functions at the same time as a central laboratory for non-destructive testing of castings, forgings, engine parts, etc.

The total yearly turnover of the Institution has grown from £1,200 in 1945 to approximately £150,000 in the present year, and so far there are no signs of any abatement in this development.

Industrial News

Home and Overseas

Telephone Number Changed

It is learned from **Heenan and Froude Ltd.** that their telephone number at their Worcester headquarters has been changed to Worcester 23461 (10 lines).

Industrial Films

Three of their latest films have been introduced this week in London by **The Carborundum Company Ltd.** These films cover the use of industrial diamonds, refractory materials and grinding wheels. Each of them are in 16 mm. sound and colour, and will run for approximately half-an-hour each. They have been made in the company's own studios.

The first film, entitled "Sparkling Performance", deals with the great value of industrial diamonds in present-day engineering, and the stone and glass trades. The second, under the title of "In the Hot Zone", is believed to be the only film on the subject of industrial heat control by the super-refractory materials, while the third film, entitled "In the Rough", presents a remarkable study of the role played by modern abrasives in the development of foundry and other heavy engineering techniques.

Sheet Metal Engineering

It has been announced that the annual Autumn Conference and Exhibition of the **Institute of Sheet Metal Engineering** is to be held on November 11 and 12, at the Charing Cross Hotel, London, W.C.2, commencing at 10.30 a.m. on the first day and at 9.30 a.m. on the second day.

A New Process

An acid fume removal process (Pat. No. 826221) has been developed to rid power station and sulphuric acid plant stacks of their sulphur nuisance, and to recover sulphur salts for use in the production of ammonium sulphate fertilizer.

In the process, devised by **Chemical Construction (G.B.) Ltd.,** ammonia gas is introduced into the flue gases between the economizer and the air heater. The gas temperature is not lowered and wet scrubbing is not used, therefore the condition favourable for causing "stack droop" is not created.

A New Product

A sanding attachment for electric drills, designed on a new principle, has been introduced by **Stanley Works (G.B.) Ltd.** Known as the "Swirlaway", the exclusive feature of this new product is the incorporation of a flexible ball joint. This is said to do away with swirls, and prevents gouges and scars. It enables the sanding disc, which is on a rubber-faced metal base, to be used flat, giving a larger sanding area than is usual.

Rapid Communication

A new airtube system designed for the rapid communication between furnace and analytical laboratory has been introduced by **Lamson Engineering Co. Ltd.** This system is operated by compressed air and can carry samples weighing 4 lb. at high temperatures and at speeds of 40-50 m.p.h.

The carrier in which the sample is conveyed has internal measurements of 2 in. diameter by 4 in. long. The head is in the form of a sleeve fitting over the carrier. The tubing in which it travels is 3 in. diameter and can be laid underground, overhead, or inside ducts. When the carrier is inserted in the end of the tube a door is shut, automatically operating an air-valve which admits compressed air for a predetermined period to propel it to the receiving end. The door then opens to allow another carrier to be inserted or one to be received.

Dickow Pumps

News from **Firth Cleveland Pumps Ltd.** is that the company is to manufacture under licence the range of self-priming multi-stage centrifugal pumps designed and developed by Dickow-Pumpen, of Wailkrayburg, near Munich. The British company will be able to sell the pumps in all parts of the world, with the exception of the Common Market countries, Scandinavia and India.

Aluminium in Building

At the forthcoming Building Exhibition in London the **British Aluminium Company Ltd.** will occupy a stand, and the main emphasis of the exhibit will be on the company's new products for the roofing and cladding of all types of building.

"Lokroll" roofing sheet, introduced at this exhibition, has been developed by the company to provide a fully-supported roof similar to the traditional batten roll, and capable of very rapid erection.

"Rigidal Seamwall" was introduced as a new development in June of this year. It is a sidewall cladding with a bold profile, designed for use in large-scale industrial buildings. It is based on a 12 in. module, and sheets are available in up to 40 ft. lengths. The company's other "Rigidal" profiles are now available in up to 40 ft. lengths.

Other exhibits on the B.A. stand will include vitreous enamelling on aluminium, e.g. for curtain walling; anodizing for interior or exterior use; tread and kick plates; roller shutters; venetian blinds; curtain walling, and a range of patterned sheet.

At the Motor Show

A new range of single-stage oxygen and acetylene regulators has now been made available by **British Oxygen Gases Ltd.** and are being exhibited for the first time at the Motor Show in London. Designed for rough service conditions where very fine pressure adjustment is not required, these inexpensive regulators weigh only 3 lb., in spite of their robust construction. They are intended for use in heating and cutting applications, and are considered particularly suitable for general cutting and "on-site" work.

Also being shown by the same company is a new welding blowpipe of exceptional lightness, which should prove of particular value in reducing operator fatigue. Known as the "Light Weight Saffire", this blowpipe, completely assembled to include one of the standard range of nozzles, weighs only 9½ oz. It has forward-mounted controls for easy adjustment, and is 13¼ in. long. This unit has been specially developed for welding sheet metal and for light welding repairs.

A Disposal Contract

Work on harbour construction at Rota, the U.S.A. naval base in Spain, is nearing completion, and a contract has been awarded to **George Cohen Sons and Company Ltd.** for the disposal of the three million dollar plant used in construction. The plant includes earth-moving equipment and dumpers, cranes of many types, compressors, piling equipment, welding sets, machine tools, and a concrete batching plant.

West German Aluminium

According to official figures issued in Düsseldorf, West Germany's aluminium production in August totalled 14,089 metric tons, compared with 14,135 tons in July. Output in the first eight months, at 96,435 tons, was three per cent higher than in the comparable period of 1958. The production of semi-manufactured aluminium goods in the first eight months of this year amounted to 118,420 tons—8·5 per cent more than in the first eight months of 1958—while at 56,916 tons, production of aluminium alloys was 3·1 per cent up.

A New Primer

A new general purpose grey primer with a drying time of only ten minutes, which can be applied to most metals, has been introduced by **Arthur Holden and Sons Ltd.** Steel, aluminium, mazak, zintec, copper and brass may be dipped, sprayed or brushed with this new product.

For handling in ten minutes and overcoating within an hour, the firm states that the new primer accepts as a second coat air drying industrial finishes, synthetic stoving enamels, stoving hammer finishes, cellulose lacquers, shrivel enamels and even decorative paints. It will take, in addition, epoxy-based heat-resisting stoving enamels such as the company is currently producing themselves for manufacturers of domestic heating appliances.

This new primer also, it is said, provides anti-corrosion protection over several months without breakdown for materials and products subjected to outdoor exposure.

Safety Exhibition

At the Industral Efficiency and Safety Exhibition, which is to open on Tuesday next in Manchester, an interesting exhibit will be provided by **Desoutter Brothers Limited.** Four new tools, all introduced within recent months, will be shown. These are a reversible screwdriver powered by the "Super Atom" motor; a corner screwdriver and nutrunner which is available in three forms; a "Super Rotor" grinder available in two forms—either as a collet type or as a spindle type; and a reversible corner nutrunner which can locate on nuts to within $\frac{11}{32}$ in. of a corner, and is powered by the new "Super Atom" reversible pneumatic motor.

Apart from pneumatic tools, the company will also be showing their range of electric tools and standardized press tool sets.

One of the new aluminium traffic signs on the London - Birmingham motorway

Aluminium Traffic Signs

In all parts of the world today, street and highway signs are increasingly being made of aluminium. We are told that some two-thirds of the total surface area of all traffic signs being operated on the London-Birmingham Motorway have been made of aluminium supplied by **The British Aluminium Company Ltd.**

The sign panels, which are made from 11 S.W.G. BA.99 per cent half-hard sheets, are cut to size and spray painted. Lettering, symbols and legends are then applied, in many cases in Scotchlite reflective sheeting. At the appropriate stage of manufacture the signs are stoved in low temperature convection ovens to provide a hard and durable finish.

The panels are attached to mild steel angle framework and tubular horizontal purlins with U-bolt attachments, which are, in turn, clamped to reinforced concrete columns. This ensures that even the large signs, some of which are 400 ft^2 in area, are unaffected even by gale force winds. The photograph of one of these aluminium signs published on this page is by courtesy of Franco-Signs Ltd.

West Germans Visit Brockhouse

A party of German journalists were guests of the **Brockhouse Organization** recently at the group's head offices and works at West Bromwich. The party was accompanied by Dr. H. J. Mangold, Commercial Counsellor of the Embassy of the Federal Republic of Germany, and Dr. Stappert, head of the commercial department of the Embassy.

After lunch with the directors, the visitors toured the various divisions of J. Brockhouse and Co. Ltd., and also the vehicle spring making factory of Richard Berry and Son.

Efco News

This month has seen the publication of the first issue of the *Efco Journal* by the **Electric Resistance Furnace Company Ltd.** The journal is intended to interconnect the thoughts of the company's engineers and metallurgists with those of metal working companies who may require modern equipment to apply the new techniques which are called for by modern engineering.

Reference is made in this first number to a remarkable installation of foundry furnaces now being completed in the ultra-modern foundry of Gebr. Sulzer A.G. in Switzerland, and modern practice in heat-treatment furnaces is described. The stress relieving of vessels for nuclear power stations, and the heat-treatment of metals for missiles, are also subjects of topical interest.

Laboratory Furniture

At the forthcoming Building Exhibition next month, there will be shown for the first time by **Griffin and George (Laboratory Construction) Ltd.,** the new Griffin-Grundy all-metal laboratory furniture. This furniture is the result of consumer research work into the requirements of scholastic, technical, university and industrial laboratories and workshops.

This new furniture is stated to have improved corrosion resistance and completely rigid construction; doors, catches and other close-mating parts are already assembled in frames so that the final assembly may be carried out by semi-skilled labour easily and quickly. It is also fire-resistant. It is made entirely from zinc-coated steel sheet for general use, but it may also be supplied in aluminium or stainless steel, or in "Stelvetite", the plastics-coated steel.

Malayan Tin Production

Statistics from Kuala Lumpur show that Malaya produced in September last 67,361 piculs of tin concentrates containing 3,039 tons of tin metal, based on the true assay of 75·80 per cent, according to an extract from Malayan mining statistics. This compared with an August output of 67,606 piculs containing 3,046 tons of tin metal, based on a true assay of 75·70 per cent. At the end of September there were 35 dredges, 356 gravel-pump mines and 42 other tin mines in operation, making a total of 433 active tin mines. The August figures were 38, 339 and 43 respectively, making a total of 420 active tin mines.

A News-Sheet

Some 35,000 copies of a "controlled circulation" newsletter have been mailed by **Midland Silicones Ltd.** to actual and potential customers. Initially appearing bi-monthly, this newsletter will feature information about the ways in which silicones are used today in almost every industry. Contents of the first issue include several stories which spotlight some of the more novel uses of silicones.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week rose 190 to 7,850 tons, comprising London 4,579, Liverpool 3,111 and Hull 160 tons.

Copper stocks fell 993 to 9,450 tons distributed as follows: London 1,773, Liverpool 5,227, Birmingham 75, Manchester 2,275 and Hull 100 tons.

Luncheon Meeting

On Wednesday of next week (November 4), the monthly luncheon meeting of **The Non-Ferrous Club** will be held at the Queen's Hotel, Birmingham, at 12.30 p.m. for 1.0 p.m. The guest speaker at this meeting will be Mr. Philip Dorté, O.B.E., Midlands Controller of Associated Television Ltd., who will talk about "Commercial Television and all that . . . ".

Nickel Exhibition

As part of the course entitled "Nickel Survey", which is being held at Hatfield Technical College, Herts., **Henry Wiggin and Company Ltd.** have been invited by the College Department of Mechanical and Production Engineering, to stage an exhibition. The exhibition, which will be open from November 17-19, will not only be an integral part of the course on nickel and its alloys, but will be of great interest to local industry.

In addition to demonstrations of the properties of Wiggin alloys—heat resistance, corrosion resistance, electrical resistance and special physical properties —the exhibition will include complete aircraft gas turbines, one of the early Whittle engines, and over 300 examples of the type of plant component and sub-assembly for which Wiggin materials are used.

New Address

It is announced by **Elliott Brothers (London) Ltd.,** a member of the Elliott-Automation Group, that its branch office in South West England and South Wales has moved to 55 Westgate Chambers, Newport, Mon., with the telephone number of Newport 65710.

New Copper Deposits

Discovery of new copper ore deposits described by experts as "practically inexhaustible" was announced last week by the director of the Bor mine. The Bor mine, in Western Serbia, is the biggest copper producer in Yugoslavia and one of the largest in Europe. Mine sources said the deposits would enable raw copper production at the Bor mine to be raised from the present 30,000 tons to 125,000 tons over the next 20 years. They added that the mine and a nearby smelting plant and fertilizer factory were being developed with the help of 40,000,000 dollars invested by French and Belgian interests. Most of the copper now produced at the mine was exported to the United States.

U.S. Tin Statistics

Tin consumption in the United States decreased 15 per cent in August 1959, according to the Bureau of Mines, United States Department of the Interior. Tin

used during the month totalled 4,760 long tons and comprised 2,185 of primary pig tin and 2,575 of secondary and imported tin-base alloys. July consumption of tin was 5,600 long tons, 3,210 of primary and 2,390 of secondary and imported tin-base alloys. As a result of the steel strike the usage of tin for tinplate dropped to 675 long tons in August, the lowest since June 1952. Total use of secondary tin increased 8 per cent, mainly for bronze and solder.

In August, brass mills used 110 long tons of tin (80 of primary pig tin and 30 of secondary pig tin and scrap). July consumption was 95 tons, comprising 55 of primary and 40 of secondary. Brass Mills' stocks of pig tin increased five tons and totalled 125 tons at the end of August. Total United States tin stocks decreased from 36,735 long tons on August 1, to 36,560 on August 31. Industrial stocks of tin in the United States decreased 320 tons to 22,675 tons during the same period. Tin metal afloat to the United States was 1,995 tons on August 31, an increase of 515 tons.

French Copper for China

It is reported from Paris that French cable manufacturers have received orders for 2,000 tons of copper wire to be supplied to China. The order was given to France by British firms within the framework of triangular operations, according to these sources. Payment will be made in sterling. Franco-Chinese trade is usually handled in convertible francs.

Sources in the China trade told Comtelburo that China had resumed general buying in France after an absence of over six months. In addition to special steel and ordinary steel orders recently, it is understood that China is enquiring for engineering products. Chinese purchases are reported to be very selective, however, and are not following a set pattern.

Total French exports to China reached 8,900 million francs in the first eight months of this year, compared with 6,875 million in the same period of 1958. Much of this reflects orders placed towards the end of last year.

Cabma Register

British Industrial products for Canada form the basis of the **"Cabma Register 1959-60"**, which has just been published. This Register has been published annually since 1953 for the Canadian Association of British Manufacturers, whose object is to develop an ever greater market for British goods in the Dominion and so stimulate the two-way flow of trade between the two countries.

The Buyers' Guide lists alphabetically some 3,000 British products available to the Canadian market, with their suppliers given under each heading. The French equivalents of these headings are set out in alphabetical order in a separate glossary. A directory of nearly 4,000 British firms gives details of their distribution arrangements in Canada. The book, covering 650 pages, is published jointly by Kelly's Directories Limited and Iliffe and Sons Limited, at the price of 15s. net, post free.

Proprietary names and trade marks are given in special sections which enable the Canadian buyer to identify products and their sources of supply. The six sections of the Register are easily identified by the slotted index and tinted paper.

Men and Metals

Appointed deputy managing director of Steele and Cowlishaw Ltd., **Mr. J. A. Harley,** was educated at Toronto University where he received the degree B.A.Sc., in mechanical engineering. He is also a member of the A.S.M.E.

It is learned from Sheepbridge Equipment Limited that **Mr. J. G. Francis** has been appointed their technical representative for the Yorkshire and Lincolnshire areas.

On Friday of last week, **Sir John M. Duncanson, Kt.,** was installed as the first president of the Institution of Nuclear Engineers at its inaugural meeting in London.

News from Deutsch and Brenner Ltd., is that **Mr. G. E. Wase** has been appointed manager of their South Wales area, operating from the area office at 21 Windsor Place, Cardiff.

A recent appointment by Aluminium Ingot Makers Limited, of Yeadon, is that of **Mr. S. C. Anthony,** F.I.M., to be general manager.

At present managing director of Petters Limited, of Staines, **Mr. D. K. Fraser,** M.I.Mech.E., M.I.Mar.E., is to join the board of G. A. Harvey and Company (London) Limited, in the near future.

Joint managing director of the Kestner Evaporator and Engineering Company, Limited, **Mr. G. H. Black** leaves London this week for a tour of America and Australia. The first week of his trip will be spent in America and the following month in Australia.

As a result of the expansion of the company's activities, Uddeholm Ltd. have appointed **Mr. A. G. Shaw** to be their Midland area manager. In this position, Mr. Shaw will be responsible for sale and service in the tool steel and heat treatment division in the Midlands.

After 72 years with the firm, and at the age of 90, **Mr. Henry Maskrey,** a director of Hall Street Metal Rolling Company Limited, of Birmingham, still visits his firm one day each week to look after the workers' welfare interests. He has been a director of the company since 1920 and still regularly attends board meetings.

Awards of the Mond Nickel Fellowships for 1959 have been made by the committee as follows: **Mr. D. J. O. Mann** (John Lysaght's Scunthorpe Works, Ltd.), to study the practical applications of recent metallurgical research and techniques to the production of basic semi-finished steel; and **Mr. N. J. B. Pocock** (Capper Pass and Son Ltd.), to study developments in extractive metallurgy in the United Kingdom, Europe, the U.S.A. and Canada, and their dependence on the size and location of the organizations concerned.

Members of the Dowty Group have reported new appointments within their companies. **Mr. A. E. Atkins,** production controller of Dowty Equipment, has been appointed general works manager of Rotol and of British Messier. **Mr. Michael C. Potts** and **Mr. Peter Sharp** have been appointed directors of Dowty Mining (Canada) and Mr. Sharp has also been appointed general manager.

It has been announced that **Field-Marshal Sir Gerald Templer** has been appointed a director and elected chairman of the British Metal Corporation. Mr. A. J. Hugh Smith has resigned as chairman on account of advancing years but is to remain on the board.

New appointments recently announced by the Yale and Towne Manufacturing Company are as follows: **Mr. Walter Anderson Galbraith,** B.A., A.M.I.Mech.E., is to be general sales manager of the company's British materials handling division at Wednesfield. Two promotions within the division have been made concurrently with this appointment: **Mr. H. Davis** has been appointed sales manager (United Kingdom), and **Mr. Michael J. Stuart** is to be sales manager (Export).

A managing director of the Royal Dutch/Shell group of companies, **Mr. L. Schepers,** has been appointed Chairman of Shell Chemical Company in succession to Mr. F. A. C. Guepin, who retired in June of this year.

Forthcoming Meetings

November 3—Institute of Metal Finishing. Midland Branch. James Watt Memorial Institute, Gt. Charles Street, Birmingham 3. "Vacuum Deposition and Lacquering for Decoration and Protection." L. Holland and D. H. Grover. 6.30 p.m.

November 3—Institute of Metals. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. "The Theory of Rolling." Prof. H. Ford. 7.0 p.m.

November 5—Institute of Metals. London Local Section. Royal School of Mines, Prince Consort Road, London, S.W.7. "The Struggle for High Temperatures." F. D. Richardson. 7.0 p.m.

November 5—Liverpool Metallurgical Society. Library of the Department of Metallurgy of the University of Liverpool, 146 Brownlow Hill, Liverpool 3. "Ductile Fracture." Prof. R. W. K. Honeycombe. 7.0 p.m.

November 5—Institute of Metal Finishing. North West Branch. Engineers' Club, Albert Square, Manchester. "Electrostatic Hand Spraying" (with demonstration). P. J. Mounce. 7.30 p.m.

Metal Market News

FOR some weeks now it has been a matter of some surprise that the price of copper has been maintained on such an even keel for there have been, and still are, very good reasons why it should advance. The strike in the United States, which has persisted very much longer than anybody expected, has cost the economy at least 120,000 tons of copper, and now the toll is beginning to mount up in Chile through the stoppage at El Teniente. Last week, however, at long last saw a change in the situation in Whittington Avenue, and a strong rise began in the quotation for standard copper. During the first half of the week, the cash price rose by nearly £10, this upward movement being touched off by a drop of 1,104 tons to 10,443 tons in the stocks of standard copper in L.M.E. official warehouses. Moreover, it was generally anticipated that this week would show a continuation of the downward trend in the stocks. Tuesday brought a report that it had been agreed to put forward to Kennecott, in New York, the latest proposals by the Unions concerned in the El Teniente dispute. Wednesday's market was particularly strong on indications that other Chilean mines might be drawn into the dispute. Not unnaturally, this idea that the trouble might spread was regarded as a strong bull point for the copper market and prices advanced sharply.

Like copper, zinc was a very strong market and had advanced by midweek between £7 and £8 with a turnover very much in excess of average. In fact, on Wednesday last week, some 3,000 tons changed hands, which was the biggest figure for many weeks past. The emphasis was on the prompt position and by midweek the backwardation amounted to at least £4. This sudden shortage in London is supposed to be due to the restrictions in production which were agreed at the United Nations Conference held earlier in the year and are likely to remain in force, at any rate to December 31. The whole object of the scheme for lowering production was to get the statistical position into better alignment, and it was thought that this had been achieved. However, last week saw a considerable increase in the rate of demand and in consequence values leapt up rapidly. In the States, the price was advanced from 12 cents to 13 cents per lb. On Thursday, a bout of profit taking brought a sharp reaction when it was known that in the United States there had been a postponement of a settlement of the steel strike. Finally, after a turnover of 10,725 tons, October zinc closed £3 10s. 0d. up at £94 5s. 0d., while January improved by £2 5s. 0d. to close at £90 15s. 0d. The margin between zinc and lead has now widened to about £23.

The amount of the advance in copper last week probably surprised everybody, although experienced observers had foreseen the development of a serious backwardation if no settlement of the strike now in being was reached. Although consumer demand on this side of the Atlantic eased off as the quotation rose rapidly, buying from the United States was insistent and Thursday saw a turnover of more than 10,000 tons on the day, with a rise in the cash price of £7 10s. 0d. On the afternoon, Kerb £255 was reported paid and the backwardation stood at £10. This development was assisted by the expectation that further drastic reductions in L.M.E. warehouse stocks would occur immediately and that squeeze conditions would persist and even get worse before any relief came. The top was reached on Friday afternoon, when £265 was paid, but profit taking caused a reaction and the close was £256 cash and £243 10s. 0d. three months. The turnover, without Kerb trading, was 33,250 tons, cash gaining £21 15s. 0d. and 3 months £9 15s. 0d. The backwardation was £12 10s. 0d. Stocks of tin declined by 537 tons to 7,660 tons, but trading was quiet with a turnover of about 400 tons. On balance, cash was unchanged at £794 10s. 0d., while three months put on £1 at £795. Lead, after some initial firmness lost ground, but closed 5s. up on balance at £70 15s. 0d. January was unchanged at £71 12s. 6d. The turnover was 7,750 tons.

Birmingham

Unemployment has dropped again in the Midlands and there are more vacancies in most metal-using industries. In Birmingham, total unemployed has fallen in a month from 6,793 to 6,326; the vacancies are up by nearly 300. At the last meeting of the Midland Regional Board for Industry, the chairman, Major C. R. Dibben, said the upward trend in trade continues with increasing impetus and the general mood is one of optimism, perhaps mildly tinged with some caution in the long term. Exports continue to be satisfactory and home demand generally continues to improve. In the motor trade, the boom is continuing, with an ever increasing demand for raw material and components.

Conditions in the iron and steel industry point to substantially larger output and consumption in the last two months of the year. To meet the pressing demands of the motor trade for cold-reduced sheets, plans have been made for increasing output as early as possible. Other branches of the steel industry are getting more orders. The light engineering industries are particularly active. More pig iron is wanted by the foundries making light castings. Makers of machine tools are busier than they have been for some months.

New York

Commodity Exchange copper, after early firmness, lost the gain on profit-taking in active dealings. Physical copper continued to boom, dealers offering prompt copper as high as 38 cents per lb., although traders said 37 to 37¼ cents per lb. was the going price for prompt and copper to be delivered to the end of December. American Metal Climax withdrew its 33 cents price as seller of domestic copper and announced it had no published price for the time being.

Zinc continued confused. A number of leading sellers moved up to 12½ cents but St. Joseph Lead reduced its price from 13 to 12½ cents to meet competition. In late dealings there was no zinc seller under 12½ cents per lb. for prime western zinc. Tin was quiet and steady.

The U.S. aluminium industry is expected to operate beyond November 1 under extended labour contracts, even if the steel strike has not been settled by then, said informed trade sources. The can industry, where labour contract prospects are also tied somewhat to a steel settlement, is already assured of operating at least until January 1, under extensions signed on September 30.

The Aluminum Company of America has a pact with the unions, including the A.F.L.-C.I.O. steel workers, which extends until November 1 from the original termination date of July 31. This pact provides for automatic extension beyond November 1, unless a ten-day termination notice is given by either side. A spokesman for Reynolds Metals Company said that "our present extension agreements with the unions are adequate to cover the present situation".

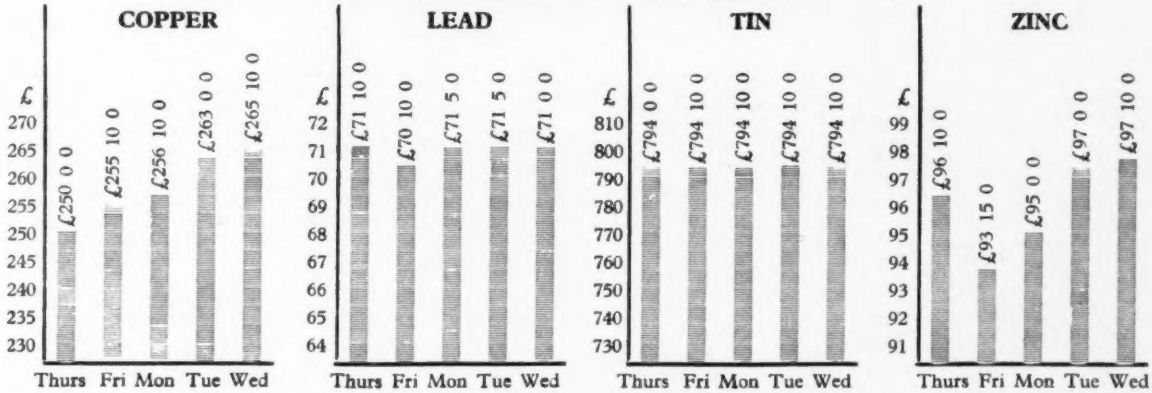
Zurich

Turnover has increased somewhat on the Swiss non-ferrous metals market recently. Trade quarters attribute this enhanced activity to the rise in world market prices as well as to seasonal rise in current demand. Buying interest, however, was limited to spot metals and there was little inclination to build up stocks in view of uncertainties about further price trends. Offerings were adequate although, according to trade quarters, less copper was available than of late. Demand for copper and zinc increased during the period under review, while business in lead was stable and sales of tin declined. Demand for aluminium increased, while the nickel position remained unchanged.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 22 October to Wednesday 28 October 1959



Primary Metals

All prices quoted are those available at 2 p.m. 28/10/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite	per unit	—		
Copper H.C. Electro.	ton	265	10	0
Fire Refined 99·70%	„	264	0	0
Fire Refined 99·50%	„	263	0	0

		£	s.	d.
Copper Sulphate	ton	76	0	0
Germanium	grm.	—		
Gold	oz.	12	10	0¾
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	71	0	0
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	72	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	nom.		
Osmiridium	„	nom.		

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.	nom.		
Silicon 98%	ton	nom.		
Silver Spot Bars	oz.		6	10¼
Tellurium	lb.		15	0
Tin	ton	794	10	0
***Zinc**				
Electrolytic	ton	—		
Min 99·99%	„	—		
Virgin Min 98%	„	94	13	9
Dust 95/97%	„	126	0	0
Dust 98/99%	„	132	0	0
Granulated 99+%	„	119	13	9
Granulated 99·99+%	„	137	5	0

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	224	168 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					230	171 10	445	262 10			29.00	232 0
Cadmium					1,300	975 0					130.00	1,040 0
Copper												
Crude												
Wire bars 99.9							475	280 2 6				
Electrolytic	32.25	237 10	29.00	238 12 6	345	268 15 0			3.00	255 0	30.00	240 0
Lead			10.75	88 12 6	104	78 0	165	97 5	.88	74 17 6	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	110.75	817 2 6			1,121	840 15	1,500	885 0	9.75	828 17 6	101.62	812 17 6
Zinc												
Prime western			12 25	101 2 6								
High grade 99.95			12 85	106 2 6								
High grade 99.99			13.25	109 5 0								
Thermic					130.00	97 12 6						
Electrolytic					138.00	103 12 6	208	122 15	1.20	102 0	14.00	112 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 28/10/59

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10....	„	221	0	0
B.S. 1490 L.M.11....	„	215	0	0
B.S. 1490 L.M.12....	„	223	0	0
B.S. 1490 L.M.13....	„	216	0	0
B.S. 1490 L.M.14....	„	224	0	0
B.S. 1490 L.M.15....	„	210	0	0
B.S. 1490 L.M.16....	„	206	0	0
B.S. 1490 L.M.18....	„	203	0	0
B.S. 1490 L.M.22....	„	210	0	0
Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	152	0	0
B.S. 1490 L.M.2	„	162	0	0
B.S. 1490 L.M.4	„	178	0	0
B.S. 1490 L.M.6	„	188	0	0
***Aluminium Bronze**				
BSS 1400 AB.1......	ton	258	0	0
BSS 1400 AB.2......	„	269	0	0

*Brass		£	s.	d.
BSS 1400-B3 65/35 ..	ton	171	0	0
BSS 249...........	„	—		
BSS 1400-B6 85/15 ..	„	220	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„	—		
(85/5/5/5) LG2	„	214	0	0
(86/7/5/2) LG3	„	224	0	0
(88/10/2/1)	„	263	0	0
(88/10/2/½)	„	277	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	204	0	0
BSS 1400 HTB2	„	220	0	0
BSS 1400 HTB3	„	234	0	0
Nickel Silver				
Casting Quality 12%	„	245	0	0
„ „ 16%	„	250	0	0
„ „ 18%	„	270	0	0
***Phosphor Bronze**				
B.S. 1400 P.B.1. (A.I.D. released)..........	„	313	0	0
B.S. 1400 L.P.B.1....	„	232	0	0

**Average prices for the last week-end.*

Phosphor Copper		£	s.	d.
10%	ton	255	0	0
15%	„	257	10	0
Phosphor Tin				
5%	„	—		
Silicon Bronze				
BSS 1400-SB1	„	275	0	0
Solder, soft, BSS 219				
Grade C Tinmans....	„	369	10	0
Grade D Plumbers ..	„	297	0	0
Grade M	„	405	10	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.	—		
Type 9 „	„	—		
Zinc Alloys				
B.S.S.1004 Alloy A ..	ton	130	10	0
B.S.S.1004 Alloy B ..	„	134	10	0
Sodium-Zinc	lb.		2	8⅛

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8⅛
Sheet 18 S.W.G.	„		2	10⅛
Sheet 24 S.W.G.	„		3	1⅛
Strip 10 S.W.G.	„		2	8⅛
Strip 18 S.W.G.	„		2	9⅛
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2⅛
Circles 18 S.W.G.	„		3	1⅛
Circles 12 S.W.G.	„		3	0⅛
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11⅛
Tubes 1 in. o.d. 16 S.W.G.	„		4	1
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3⅛
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2⅛
Strip 24 S.W.G.	„		3	10⅛
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9⅛
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0⅛
Strip 10 S.W.G.	„		3	10⅛
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9⅛
BS1477. HPC15WP.				
Plate heat treated..	„		6	3⅛
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10⅛
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0⅛
BS1476. HE10WP.				
Sections	„		3	1⅛
Brass				
Tubes	„		2	1⅜
Brazed Tubes........	„		3	3
Drawn Strip Sections	„		3	3⅞
Sheet	ton	226	10	0
Strip	„	226	10	0
Extruded Bar........	lb.		2	2⅞
Extruded Bar (Pure Metal Basis)	„	—		

Brass		£	s.	d.
Condenser Plate (Yellow Metal)	ton	213	0	0
Condenser Plate (Naval Brass)	„	225	0	0
Wire	lb.		2	10¾
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	6⅝
Sheet	ton	296	5	0
Strip	„	296	5	0
Plain Plates	„	—		
Locomotive Rods	„	—		
H.C. Wire	„	312	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	8⅞

Lead		£	s.	d.
Pipes (London)	ton	111	5	0
Sheet (London)	„	109	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7% ..	lb.		3	8⅛
Wire 10%	„		4	3⅛
Phosphor Bronze				
Wire	„		4	4¼
Zinc				
Sheet	ton	131	10	0
Strip	„	nom.		

Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia...	lb.	54/-	55/-
Rod ¼" to 4" dia.	„	95/-	62/-
Wire ·036"-·232" dia.	„	167/-	110/-
Strip ·003" to ·048" ..	„	200/-	75/-
Sheet 8'×2'. 20 gauge	„	85/-	
Tube, representative average gauge	„	300/-	
Extrusions	„	105/-	

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 27/10/59.

Aluminium	£
New Cuttings	150
Old Rolled	132
Segregated Turnings	104
Brass	
Cuttings	176
Rod Ends	161
Heavy Yellow	130
Light	124
Rolled	166
Collected Scrap	125
Turnings	154
Copper	
Wire	227
Firebox, cut up	215
Heavy	213
Light	205
Cuttings	227
Turnings	206
Braziery	170

Gunmetal	£
Gear Wheels	185
Admiralty.................	185
Commercial	170
Turnings	165
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	170
Turnings	165
Zinc	
Remelted	84
Cuttings	69
Old Zinc	48

Financial News

W. Canning and Co. Ltd.

Interim dividend on doubled Ordinary 3¼ per cent (2½ per cent equivalent) on account of 1959.

Stewarts and Lloyds

In connection with the formation of the new Stewarts and Lloyds - Imperial Chemical Industries manufacturing company, announced this week, it is understood that the new company will have a capital of £500,000, of which 65 per cent will be contributed by Stewarts and Lloyds and the remainder by I.C.I.

S.A. Minerals Corp.

Profits from manganese mining in the year ended June 30 dropped to £135,477 from £597,171 in the previous year, according to the annual report of S.A. Minerals Corp., Johannesburg. Normal production operations were suspended at the end of August 1958, and 53,589 long tons were transported to port for shipment, compared with 105,858 during the previous year. The chairman, in his statement, said that there were still no signs of a definite improvement in market conditions for manganese ore, but manganese was a metal without which modern steel-making is inconceivable. Steel production and consumption had been expanding at an ever-increasing rate, and there was no reason to believe that the present phase was more than a temporary setback and that, sooner or later, steel consumption would not resume its normal increasing rate of expansion, with corresponding benefits for the manganese mining industry.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

G. Hill (Portsmouth) Limited (637861), Clifton Street, Portsmouth. Registered September 24, 1959. To carry on business of merchants, manufacturers of and dealers in scrap metal and waste products, etc. Nominal capital, £12,000 in £1 shares. Permanent directors: Henry G. Earl and Mrs. Clara L. Earl.

Newgate Foundry Co. Limited (637986), Newgate, Barnard Castle, Co. Durham. Registered September 25, 1959. To carry on business of wood and metal patternmakers, toolmakers and model makers, etc. Nominal capital, £10,000 in £1 shares. Directors: John Vickers, Tom Wolverson and Ernest Taylor.

Whitehall Metal Products Limited (638041), 61 Cowper Road, Whitehall Gardens, Bromley, Kent. Registered September 25, 1959. Nominal capital, £300 in £1 shares. Directors: Edgar Hopkins and George E. Pace.

Shaws Metals Limited (638175), Gosforth Road, Osmaston Park, Industrial Estate, Derby. Registered September 28, 1959. To carry on business of dealers in and importers and exporters of metals and minerals of all kinds, etc. Nominal capital, £3,000 in £1 shares. Directors: John H. Shaw and Kenneth J. Shaw.

P.P. Pressings Limited (638250), 56 Newhall Street, Birmingham, 3. Registered September 29, 1959. To carry on business of manufacturers of and dealers in metal parts for the light engineering industry, etc. Nominal capital, £100 in £1 shares. Directors: Frank L. B. Sale, Cecil A. Sale, Mrs. Lois M. Sale and Mrs. Iris M. Sale.

Midland Chromium Plating Company Limited (638397), 80-96 Hockley Street, Birmingham 18. Registered September 30, 1959. Nominal capital, £5,000 in £1 shares. Directors: Albert W. Merrington and Mrs. Gwendoline E. Merrington.

Wilson & Wright Limited (638857), Carr Lane, Glasshoughton, Castleford. Registered October 6, 1959. To carry on business of scrap metal merchants, metal and machinery merchants, etc. Nominal capital, £2,000 in £1 shares. Directors: James Lumb, Mrs. Elizabeth Lumb, Beryl Holmes, Harry Wright and Alfred Wright.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£223.7.0)	255
Heavy copper	(£219.0.0)	250
Light copper	(£188.7.6)	215
Heavy brass	(£131.10.0)	150
Light brass	(£97.5.0)	111
Soft lead scrap	(£59.17.6)	68
Zinc scrap	(£48.2.6)	55
Used aluminium unsorted	(£105.2.6)	120
France (francs per kilo):		
Electrolytic copper scrap	(£202.10.0)	270
Heavy copper	(£202.10.0)	270
No. 1 copper wire	(£187.12.6)	250
Brass rod ends	(£135.0.0)	180
Zinc castings	(£56.2.6)	75
Lead	(£69.0.0)	92
Aluminium	(£135.0.0)	180

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£200.15.0)	340
Aluminium copper alloy	(£150.10.0)	255
Lead, soft, first quality	(£126.0.0)	135
Lead, battery plates	(£45.0.0)	76
Copper, first grade	(£224.5.0)	380
Copper, second grade	(£212.10.0)	360
Bronze, first quality machinery	(£209.10.0)	355
Bronze, commercial gunmetal	(£180.0.0)	305
Brass, heavy	(£153.10.0)	260
Brass, light	(£138.12.6)	235
Brass, bar turnings	(£141.12.6)	240
New zinc sheet clippings	(£70.12.6)	120
Old zinc	(£56.0.0)	95

Trade Publications

Paints and Finishes. — Jenson and Nicholson Ltd., Stratford, London, E.

This 25-page illustrated book on marine paints and finishes is intended as a quick reference to all types of marine finishes and their application.

Raising Productivity.—The British Productivity Council, 21 Tothill Street, London, S.W.1.

That there is considerable scope for raising productivity and lowering costs in smaller firms by the use of modern methods and techniques of management is amply demonstrated in a new booklet published by the Council. Based largely on the work of the National Union of Manufacturers' Advisory Service, the booklet describes what has been done in 12 typical small firms through techniques such as work study, costing, production control, office organization, and incentive schemes.

S.S. News Letter.—Solus-Schall Limited, 15-18 Clipstone Street, London, W.1.

The latest issue of this publication contains an interesting article on non-destructive testing, some notes on a pneumatic gamma-ray source container, ultrasonic examinations of cast iron, and the ARQ demagnetizer.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for July, 1959, have been issued by the Ministry of Supply as follows (in long tons):—

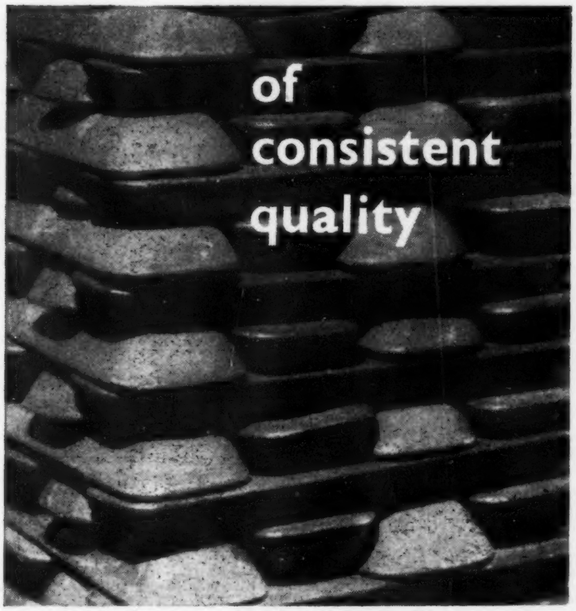
Virgin Aluminium	
Production	1,997
Imports	14,331
Despatches to consumers	18,931
Secondary Aluminium	
Production	9,581
Virgin content of above	862
Despatches (including virgin content)	9,189
Scrap	
Arisings	12,543
Estimated quantity of metal recoverable	8,895
Consumption by:	
(a) Secondary smelters	11,704
(b) Other uses	1,060
Despatches of wrought and cast products	
Sheet, strip and circles	12,018
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	3,105
(b) Tubes (i) extruded	300
(ii) cold drawn	602
(c) (i) Wire	1,964
(ii) Hot rolled rod (not included in (c) (i)	61
Forgings	315
Castings: (a) Sand	1 476
(b) Gravity die	3,975
(c) Pressure die	1,672
Foil	1,952
Paste	404
Magnesium Fabrication	
Sheet and strip	5
Extrusions	99
Castings	163
Forgings	6

THE STOCK EXCHANGE

Market Generally Very Firm On Steady Investment Buying

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 26 OCTOBER	+RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	29/-	+1/6	9	9	6 4 3	29/-	23/3	24/9	17/6
400,000	2/-	Anti-Attrition Metal	1/3		4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	66/9		15	15	4 10 0	67/-	54/-	58/9	46/6
1,613,280	1	Birfield	70/-	+5/6	15	15	4 5 9	75/-	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	99/6	+1/-	17½	17½	3 10 3	100/-	72/-	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	58/3	+5/9	11	10	3 15 6	58/9	36/1½	39/-	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/9		5	5	6 7 0	16/3	15/-	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	18/7½		6	6	6 8 9	18/10½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	34/6		10	10	5 16 0	34/6	27/6	28/9	24/-
300,000	1	Ditto Pref. 5%	15/-		5	5	6 13 3	15/6	14/-	16/-	15/-
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	20/6	20/-	20/4½	19/-
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/9		6	6	6 1 6	20/7½	18/9	20/-	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	58/6	+1/-	12½	12½	4 5 6	61/-	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	76/6	+1/-	10	10	2 12 3	78/-	49/3	52/-	28/3
1,200,000	Stk. (5/-)	Canning (W.) & Co.	16/-	+1/6	25+ *2½C‡	25	3 18 0	16/-	12/3	25/3	19/3
60,484	1/-	Carr (Chas.)	2/-	+1½d.	12½	25	6 5 0	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	26/3		10	10	7 12 6	27/-	22/6	22/-	16/-
45,000	1	Ditto Cum. Pref. 6%	16/9		6	6	7 3 3	17/-	15/3	16/-	15/-
250,000	2/-	Coley Metals	3/-		15	20	10 0 0	4/-	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	74/6	+7/-	15	18¾	4 0 6	75/9	59/-	65/3	41/-
1,509,528	1	Davy & United	101/6	+4/6	30‡	20	2 19 0	102/-	43/1½	87/-	45/9
6,840,000	5/-	Delta Metal	19/10½	—6d.	31‡	30	3 18 0	21/-	12/-	25/-	17/7½
5 296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	60/-	+2/-	15	12½	5 0 0	60/-	36/7½	38/-	22/9
750,000	1	Evered & Co.	35/9	+4½d.	10§	15D	5 11 9	35/9	30/-	30/-	26/-
18,000,000	Stk. (£1)	General Electric Co.	45/9	—1/3	10	10P	4 7 6	48/9	30/-	40/6	29/6
1,500,000	Stk. (10/-)	General Refractories Ltd.	43/3		20	20	4 12 6	43/3	31/9	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	64/-	+1/-	16½	15	5 3 0	66/6	63/-	67/6	61/-
750,000	5/-	Glacier Metal Co. Ltd.	9/9	+9d.	11½	11½	5 18 0	9/9	6/7½	8/3	5/-
1,750,000	5/	Glynwed Tubes	25/-	+2/-	20¶	20	4 0 0	25/-	16/4½	18/1½	12/10½
5,421,049	10/-	Goodlass Wall & Lead Industries ...	47/6	—1/-	13‖	18D	2 14 9	48/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	105/-		30	20	5 14 3	108/3	75/-	57/9	45/-
396,000	5/-	Harrison (B'ham) Ord.	24/6	+1/6	*17½	*15	3 11 6	24/6	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/-	Heenan Group	13/3		10	10‡	3 15 6	13/3	7/6	9/7½	6/9
246,209,422	Stk. (£1)	Imperial Chemical Industries ...	53/9	—6d.	12DZ	10	2 19 6	56/6	33/9	38/-	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	18/3	+9d.	5	5	5 9 6	18/3	16/-	17/1½	16/-
14,584,025	**	International Nickel	175	+3	$2.60	$3.75	2 12 6	187¾	154½	169	132¾
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	+6d.	5	5	6 3 0	16/3	15/4½	16/9	15/-
6,000,000	1	Ditto Ord.	44/6	—6d.	12D	10	3 12 0	46/3	29/7½	47/-	36/6
600,000	10/-	Keith, Blackman	31/3		17½E	15	4 7 0	31/3	25/-	28/9	15/-
320,000	4/-	London Aluminium	6/7½	+3d.	10	10	6 0 9	6/10½	5/3	6/-	3/-
765,012	1	McKechnie Brothers Ord.	51/-	+5/-	15	15	5 17 9	51/-	41/-	45/-	32/-
1,530,024	1	Ditto A Ord.	50/-	+6/-	15	15	6 0 0	50/-	38/9	45/-	30/-
1,108,268	5/-	Manganese Bronze & Brass	18/-		20⅝	20	5 12 9	18/-	13/9	14/1½	8/9
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	73/6	+1/6	11	11	3 0 0	80/-	44/7½	73/3	40/6
415,760	Stk. (2/-)	Metal Traders	12/-	+2/-	50	50	8 6 9	12/3	8/4½	9/-	6/3
160,000	1	Mint (The) Birmingham	29/-		10	10	6 18 0	29/-	22/-	22/9	19/-
80,000	5	Ditto Pref. 6%	80/-		6	6	7 10 0	75/6	69/-	83/6	69/-
5,187,938	Stk. (£1)	Morgan Crucible A	47/-xcap	+5/3	10ϕ	10	3 0 9	47/-	43/6	45/-	34/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/-	+6d.	5½	5½	6 2 3	18/6	17/6	18/-	17/-
2,200,000	Stk. (£1)	Murex	56/9		15	17½	5 4 0	58/3	41/-	58/9	46/-
468,000	5/-	Ratcliffs (Great Bridge)	12/9		10R	10	3 18 6	12/9	9/6	11/1½	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	54/-	+13/-	25	20	4 12 6	54/-	27/9	27/3	24/6
1,365,000	Stk. (5/-)	Serck	30/-	+3d.	17½GB	15	3 6 9	30/-	18/-	18/7½	11/-
6,698,586	Stk. (£1)	Stone-Platt Industries	62/6	+2/6	15	15	4 16 0	63/-	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/9		5½	5½	6 4 0	18/-	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	109/-	+2/9	17½	15	3 4 3	113/-	72/-	86/-	48/4½
41,000,000	Stk. (£1)	Vickers	29/10½	—2/1½	10	10	6 13 9	37/-	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/-		5	5	6 13 9	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3		*5	*5	6 19 0A	22/7½	20/6	23/-	21/3
2,200,000	1	Ward (Thos. W.), Ord.	142/6	+3/9	20	15	2 16 3	147/6	83/-	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	52/3	—1/-	10	10	3 16 6	53/9	39/9	46/6	32/6
225,000	2/-	Wolverhampton Die-Casting ...	13/-	+1/6	30	25	4 12 3	13/3	8/8½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	30/-		27½	27½	4 11 9	32/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	7/1½		20	20	7 0 6	7/6	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9		6	6	8 14 9	13/9	12/10½	13/-	11/3
150,000	1/-	Zinc Alloy Rust Proof	3/1½	—3d.	27	40D	8 12 9	3/9¾	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. § And Special distribution of 2½% free of tax. D And 50% capitalized issue. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. ¶ Interim since increased from 10% to 12%. ϕ And 40% capitalized issue. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. Z Interim since increased. B And proposed 50% capitalized issue. G And 1½d. special distribution.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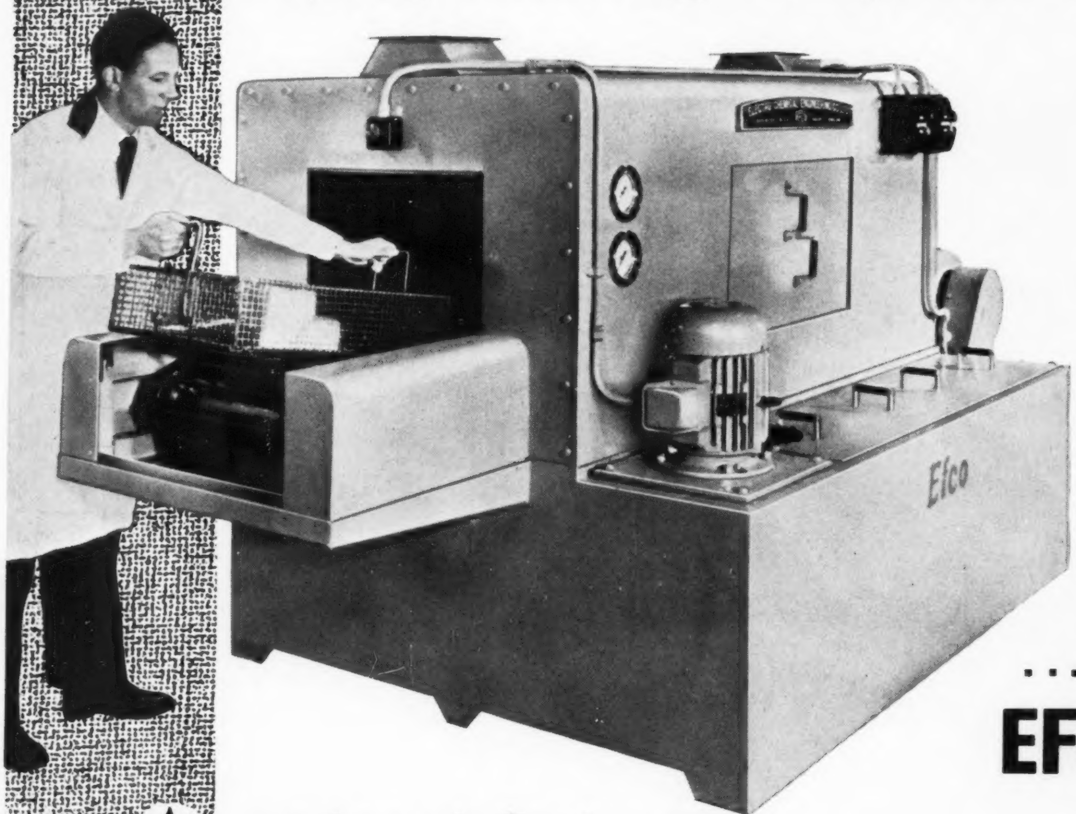

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